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Chapter

1

1 Preface

The purpose of this guide is to meet the needs of people who require an authoritative point of technical reference and advice to support their involvement in designing, developing, acquiring or deploying software applications that uses SNOMED Clinical Terms.

SNOMED Clinical Terms continues to evolve to further enhance its ability to represent clinical information and there is a growing body of knowledge about how best to use it. As a result future releases of the guide may include additional detail, revised advice and notes on significant changes to specifications.

This guide is available in two forms:

• **WebHelp (HTML)**: (file suffix .html)
  - A hyper-linked version viewable in a standard web-browser.
  - This version includes searching and glossary lookups.
  - The web-based version is most effectively when used online. Some features may not work on a local version of this resource.

• **Adobe Acrobat**: (file suffix .pdf)
  - A browsable and printable version arranged for page layout rather than in separate topics.
  - The text content is identical to the HTML version but there are some difference to navigation and cross references resulting from page oriented formatting.
  - This version is searchable.

A version of each of the above is available configured for the US English and GB English. Note that the PDF versions are formatted for different paper sizes (US - Letter, GB - A4).

1.1 Notation used in this document

The following notation is used in this User Guide to represent key types of SNOMED CT information:

*SNOMED CT concept* names are generally represented using the *Fully Specified Name* in mixed case formatted as in the following example:

**Example:** | Peribronchial pneumonia (disorder) |

*SNOMED CT attribute names* are preceded and followed by a vertical bar. In some cases, to make them stand out they are presented in all capital letters as in the following example, though this is not to be considered a standard form for rendering attribute names:

**Example:** | FINDING SITE |
1.2 Document Properties

Table 1:

<table>
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<th>SNOMED CT Technical Implementation Guide</th>
</tr>
</thead>
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<td>See cover for version and date</td>
</tr>
<tr>
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<td>David Markwell</td>
</tr>
<tr>
<td>Subject:</td>
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Table 2: Amendment History

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<td>2002-02-31</td>
<td>Initial draft of TIG provided with first SNOMED CT release published by College of American Pathologists (CAP).</td>
</tr>
<tr>
<td>2 to 5</td>
<td>2002-07-31 to 2007-01-31</td>
<td>Updates published by CAP on a six-monthly or annual basis with SNOMED CT International Release.</td>
</tr>
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<td>6 to 11</td>
<td>2007-07-31 to 2011-07-31</td>
<td>Updates published by IHTSDO on a six-monthly or annual basis with SNOMED CT International Release. Including move to online HTML version.</td>
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<tr>
<td>12 to 15</td>
<td>2012-01-31 to 2013-07-31</td>
<td>Regular six-monthly updates including introduction of Release Format 2 and gradual removal of Release Format 1 specific material to a separate RF1 Guide. During this period changes to the documents were substantially informed by comments and corrections posted to the IHTSDO Document Issue Tracker.</td>
</tr>
<tr>
<td>16.00</td>
<td>2014-01-31</td>
<td>DMA</td>
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</table>

1.3 Status

This guide contains parts and sections which differ in terms of the authority and status of their content. Each section of the guide is marked to indicate its publication type and status using the symbols shown in Table 3 and Table 4.

Table 3: Document Types

<table>
<thead>
<tr>
<th>Type Name and Description</th>
<th>Draft</th>
<th>Review</th>
<th>Current</th>
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</tbody>
</table>
A document or other resource that is intended to be authoritative. This includes specifications of SNOMED CT content and release files. Normative requirements for particular functions are also standards.
<table>
<thead>
<tr>
<th>Type Name and Description</th>
<th>Draft</th>
<th>Review</th>
<th>Current</th>
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</thead>
<tbody>
<tr>
<td>Guidance</td>
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<tr>
<td>A document or other resource that is intended to provide advice or suggest possible approaches to particular requirement or subject area.</td>
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Table 4: Document Status

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<tr>
<td>Indicates that the document or resource is considered to be up-to-date and complete for the current release of SNOMED CT (indicated by an explicitly stated version date or by the publication date).</td>
<td></td>
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<tr>
<td>Review</td>
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<tr>
<td>Indicates that the document or resource has been released for review and comments from SNOMED CT users and other stakeholders. It is intended to be complete but has not been formally approved as a final version.</td>
<td></td>
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</tr>
<tr>
<td>Draft</td>
<td></td>
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</tr>
<tr>
<td>Indicates that the document or resource is a draft version. It may be incomplete and has not been approved in a final version.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This edition of the document is configured to use GB English.

The PDF version of this draft is formatted to be printed on A4 paper.

Note: This is one of several large documents that are regularly revised by the IHTSDO. Therefore, for the sake of the environment, please think carefully before deciding to print the entire document.

1.4 Referencing and Commenting

This document contains a way to reference topics a way that is not dependent on changes to the structure of the document as new versions are released including additional topics. These references are web addresses that will point to the latest version of and topic in the document.

If you are using the PDF version of the document there are three icons to the right of each title which provide useful information and relevant links.

- The \( S \) icon indicates the status of the topic (see Status).

- The \( W \) icon provides a link to the web address to access and reference this topic online. Please use this reference to identify or share references to the topic as section and page numbers change between versions.
The icon links directly to a page where you can submit comments or report errors about this topic. The comment tracker is an online resource that requires you to login to an IHTSDO CollabNet account. If you do not have an account, there is an option to create an account available on the login page.

If you are using the online web version of this document then there is a single bookmark icon which, when clicked, opens a small form with an easy copy and paste option for access to the topic reference and button to click to take you direct to the comment tracker.

### 1.5 Additional information

Further information about SNOMED CT is available by contacting IHTSDO:

**IHTSDO Contact Details:**
- **Web:** [www.ihtsdo.org](http://www.ihtsdo.org)
- **Email:** support@ihtsdo.org
- **Address:**
  - IHTSDO
  - Gammeltorv 4, 1.
  - 1457 Copenhagen K
  - Denmark
- **Tel:** +45 3644 8736
- **Fax:** +45 4444 8736

### 1.6 Inventory of Documentation

The following SNOMED CT documentation is made available to accompany the International Release of SNOMED CT from the International Health Terminology Standards Development Organisation (IHTSDO).

In the following listing hyperlinks are provided which will be maintained to point to the latest version of each of these documents.

- A list of documents, including a wider range of versions, is available from: [www.snomed.org/doc](http://www.snomed.org/doc).

**SNOMED CT Starter Guide**

- On line HTML version: *not currently available in HTML - please download one of the PDF versions*

The Starter Guide is the ideal place to start learning about SNOMED CT. It covers a wide range of topics related to SNOMED CT at a fairly high-level but with sufficient detail to be useful to most readers.
**Note:**

The Starter Guide replaces the previously published User Guide.

**SNOMED CT Technical Implementation Guide (TIG)**

- On line HTML version: [www.snomed.org/tig](http://www.snomed.org/tig)
- PDF version UK English A4 page size: [www.snomed.org/tig_gb.pdf](http://www.snomed.org/tig_gb.pdf)

The TIG is intended for SNOMED CT implementers, such as software designers. The TIG assumes information technology and software development experience. Clinical knowledge is not required, although some background is helpful to understand the application context and needs.

The TIG contains guidelines and advice about the design of applications using SNOMED CT, and covers topics such as **Terminology services**, entering and storing information, and migration of legacy information.

**SNOMED CT Editorial Guide**

- On line HTML version: [www.snomed.org/eg](http://www.snomed.org/eg)
- PDF version UK English A4 page size: [www.snomed.org/eg_gb.pdf](http://www.snomed.org/eg_gb.pdf)

The Editorial Guide is intended for clinical personnel, business directors, software product managers, and project leaders; information technology experience, though not necessary, can be helpful.

The Editorial Guide is intended to explain SNOMED CTs capabilities and uses from a content perspective. It explains the content and **concept model**, and the principles used to edit the terminology.

**IHTSDO Glossary (DRAFT)**

- On line HTML version: [www.snomed.org/glossary](http://www.snomed.org/glossary)
- PDF version UK English A4 page size: [www.snomed.org/glossary_gb.pdf](http://www.snomed.org/glossary_gb.pdf)

**SNOMED CT ICD-10 Mapping Specification**


This document describes the mapping use cases and technical procedures applied to the co-development of a SNOMED CT to ICD-10 map by IHTSDO and the World Health Organization (WHO). It provides guidance on the intended purposes and practical use of the mapping files produced from this development.

**SNOMED CT Release Format 1 Guide**

- On line HTML version: [www.snomed.org/rf1](http://www.snomed.org/rf1)
- PDF version US English Letter page size: [www.snomed.org/rf1.pdf](http://www.snomed.org/rf1.pdf)
- PDF version UK English A4 page size: [www.snomed.org/rf1_gb.pdf](http://www.snomed.org/rf1_gb.pdf)

The RF1 Guide provides technical information relevant to those using the original SNOMED CT Release Format. Although this format was replaced by RF2 in January 2012, the old format is being maintained for a transitional period.

**SNOMED CT Non-Human Refset Guide**


A guide to use of the “Non-Human” Simple Reference Set that contains concepts and terms that are only used in veterinary medicine. This guide applies to content that is dated July 2013 or before. As of the January 2014 International Release, non-human concepts have been moved to an extension.

**SNOMED CT Developer Toolkit Guide**


A guide to use of value-added files and scripts that are provided as a toolkit available as part of the SNOMED CT International Release.
Additional Documentation: The following materials previously published in separate documents are now integrated as part of the Technical Implementation Guide.

- Technical Reference Guide
- Namespace Identifier Guide
- Namespace Identifier Registry
- File Naming Convention
- RF2 Data Structures Specification
- RF2 Reference Set Specifications
- RF2 Update Guide
- Stated Relationships Guide
- Canonical Table Guide (previously included in RF1)

1.7 Where is the Glossary?

Some versions of documents may contain a glossary section. However, we are also developing a separate IHTSDO Glossary document which is currently available in a draft form. The intention is to move towards using this single common resource make it easier to ensure consistency across the IHTSDO community.

The current version of the IHTSDO Glossary is available as follows:

- On line HTML version: www.ihtsdo.org/glossary
- PDF version UK English A4 page size: www.ihtsdo.org/glossary_gb.pdf
- You can create links that query the glossary use the following web address pattern "www.ihtsdo.org/define/word or phrase". The following examples can be tested and you can include these types of reference in your documents to make it easy to refer to the IHTSDO glossary definitions:
  
  - www.ihtsdo.org/define/ihtsdo
  - www.ihtsdo.org/define/snomed ct
  - www.ihtsdo.org/define/affiliate licence

1.8 Copyright Notice

Copyright Notice:

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SNOMED CT has been created by combining SNOMED RT and a computer based nomenclature and classification known as Clinical Terms Version 3, formerly known as Read Codes Version 3, which was created on behalf of the UK Department of Health.

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of this document who has received it by other means is encouraged to obtain a copy directly from the IHTSDO, or a Member of the IHTSDO. (Details of the Members of the IHTSDO may be found at www.ihtsdo.org/members/).
The overall structure of the guide is not intended as a suggested reading order but to provide a predictable location for each broad category of information. Thus as the guidance is extended and revised new sections will appear within the relevant locations rather than as separate documents.

The guide is divided into several parts each of which focuses on a particular aspect of technical implementation. The sections are interdependent and are extensively cross-linked. These links are used to avoid duplication and aid consistent maintenance.

- **Structure and Content Guide (4):**
  - This part of the guide provides reference material on the technical design of SNOMED CT. These design features provide the foundation for the services described in subsequent parts of the guide.
  - The design features include: SNOMED CT components (concepts, description and relationships), extensibility mechanisms (reference sets), content extensions and expressions that are used to represent information within a electronic record.

- **Release File Specifications (5):**
  - This part of the guide includes detail Descriptions of the files used to distribute SNOMED CT content to licensees;
  - The specification are an important source of technical reference for those developing and maintaining applications that provide access to SNOMED CT content.

- **Concept Model Guide (6):**
  - This part of the guide describes the ways in which technical design of SNOMED CT is populated with content. The Concept Model specifies the main hierarchies in which concepts are arranged and the types of the relationships that are permitted between them.
  - This Concept Model is directly relevant to implementation because it determines the types of clinical ideas that can be expressed using SNOMED CT and the ways in which these ideas can be refined to represent more detailed information.

- **Terminology Services Guide (7):**
  - This part of the guide describes the types of services required to access and make use of SNOMED CT. It also provides practical advice on effective ways to deliver these services based on practise experience.
  - These services include: importing distribution files, determining the status and properties of selected components, searching for terms, navigating hierarchies, testing and using relationships between concepts, working with references sets to determine language acceptability, membership of value sets, maps to other classification and additional annotations and metadata.

- **Record Services Guide (8):**
  - This part of the guide describes the types of services required to use SNOMED CT, to represent instances of clinical information in electronic health records, knowledge resources, decision support algorithms and data retrieval specifications.
  - These services include, entry of expressions (including postcoordinated refinements), storage of expressions, communication and selective retrieval of information that uses SNOMED CT expressions to represent clinical ideas.
  - As part of the consideration of storage, communication and retrieval, this part of the guide also discusses the integration of the terminology with a well-designed information model. It is now widely
recognised that this is crucial element in design and development of a SNOMED CT enabled application.

• Record services are dependent on Terminology services and these two sets of services may be tightly integrated. Alternatively, an application that delivers record services may use a third party terminology server to reduce the required development.

• Change Management Guide (9):
  • This part of the guide addresses requirements that arise from changes to the content, structure and use of SNOMED CT.
  • The first significant change management challenge relates to migration from other coding schemes or from a less structured electronic record system. Decisions must be made about retaining or converting records, queries and protocols originally created using a terminology other than SNOMED CT.
  • Each release of SNOMED CT introduces some changes to content. From time to time there will also be changes designed to increase the expressivity of the Concept Model. Occasionally there may also be additional technical artefacts or specification developed to meet emerging requirements.
  • As systems evolve and as the content and structure of SNOMED CT are enhanced there is a continuing requirement to address to manage changes smoothly and without loss of information or functionality.

• Extension Services Guide (10):
  • This part of the guide describes additional services which some advanced users or implementers may require to allow them to create or maintain Extensions for use in a particular country, organisation or specialty.
  • The most common of these requirements will be to support the creation and maintenance of specialised Reference sets. Uses for Reference Sets include representation of value sets, marking descriptions to indicate acceptability of terms in a specific language or specialty, alternative hierarchies, cross mapping to classifications and annotations.

2.1 Who Should Read This Guide?

The guide can be used in various ways to assist the design, evaluation, operational implementation and use of various types of software applications that use SNOMED CT. The intended audience includes systems developers, health informatics specialists, purchasers, and system integrators.

2.1.1 Software designers and developers
  • Software designers and developers should use this guide:
    • To enhance their technical understanding of SNOMED CT and the value it offers to their applications;
    • As a point of reference when designing a SNOMED CT enabled application and when planning and undertaking the required development.
  • Designers and developers of fully integrated applications should use the guide:
    • As a checklist of SNOMED CT services necessary to meet the needs of their users;
    • For advice on how to implement the required services in ways that make the best use of SNOMED CT and which avoid known pitfalls.
  • Designers and developers of terminology servers should use the guide:
    • As a checklist when deciding which SNOMED CT services their server should offer;
    • For advice on ways to implement the required services in ways that make the best use of SNOMED CT and avoid known pitfalls;
    • As a point of reference when describing the functionality of their server.
  • Designers and developers of applications that use Terminology services should use the guide:
• As a checklist of SNOMED CT services necessary to meet the needs of their users;
• To assist consideration of whether to use a terminology server;
• As a point of reference when reviewing the functionality of terminology servers.

2.1.2 Health informatics specialists, analysts, purchasers and integrators

• Health informatics specialists, analysts, purchasers and integrators should use this guide:
  • To enhance their technical understanding of SNOMED CT and the value it offers to their organisation;
  • As a point of reference when specifying, procuring and evaluating SNOMED CT enabled applications.

• Health informatics specialists analysing the needs of users and organisations should use this guide:
  • As a checklist of SNOMED CT services necessary to meet the needs of their users;
  • For advice on known pitfalls when implementing clinical terminologies;
  • To assist decisions on technical approaches to design and implementation of applications that use SNOMED CT.

• Purchasers of healthcare information systems should use this guide:
  • As a checklist when specifying procurement requirements for applications that use SNOMED CT;
  • As a starting point for the evaluation of the SNOMED CT related technical features of the available systems.

• Healthcare information systems integrators should use this guide:
  • As a checklist for confirming the claimed functionality of SNOMED CT enabled applications;
  • For advice on alternative approaches to integration of SNOMED CT related services into a wider information system.

• Information systems departments and project teams should use this guide:
  • As a checklist for the SNOMED CT related functionality needed to meet the requirements of their users;
  • For advice on alternative approaches to delivery and maintenance of SNOMED CT related functionality as part of an operational information system.

2.2 Important Notices

Note: The IHTSDO supplies SNOMED CT as a set of release files that are designed to be loaded into healthcare software applications such as Electronic Health Records. This guide describes services that should be provided by software applications that implement SNOMED CT.

Note: The IHTSDO does not create or market healthcare software applications but seeks to promote implementation and innovation by promoting a market place in which SNOMED CT is equally accessible to all software developers, vendors and health service providers.

Note: This guide refers to files that are included in the International Release of SNOMED CT provided to licensees by the IHTSDO. It also refers to additional files that are included in SNOMED CT Extensions provided by IHTSDO Members and Affiliates. Details of the licensing arrangements for SNOMED CT and contact details for IHTSDO Members are available from the IHTSDO web site:

  • www.ihtsdo.org
2.3 Additional information and feedback

Further information about SNOMED CT is available on the Internet at:

• www.ihtsdo.org

Please send feedback by email to:

• support@ihtsdo.org

or contact the International Health Terminology Standards Development Organisation at:

• IHTSDO
• Gammeltorv 4, 1.
• 1457 Copenhagen K
• Denmark
•
• Tel: +45 3644 8736
• Fax: +45 4444 8736
Chapter 3

3 SNOMED CT implementation

This part of the guide introduces the rationale for implementing SNOMED CT. It identifies some of the types of software application that benefit from the features of SNOMED CT. It sets out some broad parameters that determine the extent to which an application can make use of particular aspects of SNOMED CT and outlines some approaches to delivering the required services.

3.1 Motivation for Implementation

SNOMED Clinical Terms (SNOMED CT) is widely recognised as the leading global clinical terminology for use in electronic health records. It is maintained and developed by an International body (the IHTSDO) which has a growing community of Members and Affiliates. It is available free for use in IHTSDO Member countries and can also be used in other countries based on openly published licensing terms that are designed to be affordable. IHTSDO policies allow for the open involvement of its Members and Affiliate Licensees in the development of content and the design of future enhancements.

The features of SNOMED CT include:

• A broad scope that covers most of the clinical concepts used in patient centered clinical records;
• Ability to express different levels of clinical detail in patient record entries by using expressions containing one or more concept identifiers;
• Relationships between concepts that enable consistent retrieval of a common form of clinical information for many different purposes;
• Extensible design allowing graceful, evolutionary enhancement and addition of national, local or specialty content within a coherent standard structure;
• A reference set mechanism to support representation of language / dialect variants, value sets, alternative hierarchies and mapping to classifications;
• Component permanence with history tracking;
• Good compliance with the essential features for future clinical terminologies as identified by JJ Cimino in his peer acclaimed 1998 paper.

SNOMED CT is designed to enable effective representation of clinical information in electronic health records. While there are other potential uses for SNOMED CT, the potential benefits are greatest where it is implemented as a part of a Clinical Information System centered on the delivery of health care services to individuals and populations.

The benefits actually realised by implementation depend on the technical design of applications and the way they integrate SNOMED CT with other essential elements. These technical issues are addressed in this guide. Another critical success factor is a process for managing implementation across an organisation, region or country. Although the guide does not address broader issues of operational implementation within an organization, it does provide a key source of reference for those specifying the practical details of a plan for large scale implementation of SNOMED CT.

3.1.1 Benefits for electronic health records

Implementation of SNOMED CT, as part of a well-designed Clinical Information System, is the key to unlock many of the potential benefits of electronic health records.

SNOMED CT enables consistent representation of clinical information within electronic health records. Its content and design allow most types of clinical information to be represented at levels of detail.
appropriate to a wide range of different use cases. The hierarchical and defining relationships of SNOMED CT facilitate effective meaning-based retrieval and reuse of this information. By using these relationships, a SNOMED CT enabled application can query electronic health records to extract, analyse and aggregate relevant data recorded in different settings and at different levels of detail.

Many of the benefits of electronic health records require an effective retrieval and reuse of clinical information. These include:

- Enhancing the care of individual patients:
  - Display of appropriate information to enable clinical staff to assess the condition and needs of patients;
  - Decision support tools that help to guide safe, appropriate and effective patient care;
  - Communicating, sharing and maintaining information in ways that enable different members of the health care team to access and use relevant information collected at different places and times.

- Enhancing the care of populations of patients:
  - Epidemiology monitoring and reporting;
  - Research into the causes of diseases;
  - Research into the effectiveness of different approaches to disease management and treatment.

- Supporting cost-effective delivery of care:
  - Using decision support to minimise the risk of costly errors in treatment;
  - Reducing duplication of investigation and interventions through effective access to shared information about the patient;
  - Auditing the delivery of clinical services; with more opportunity to analyse outliers and exceptions in the pattern of care delivery;
  - Planning future service delivery based on emerging health trends, perceived priorities and changes in clinical understanding.

Delivering these benefits depends on consistent representation of the various types of information that are represented in a health record. It must be possible to represent this information at different levels of detail and it must be possible to query this information from various perspectives and at different levels of detail. To meet these requirements electronic health records need a well-maintained terminology that meets the criteria specified in Desiderata for Controlled Medical Vocabularies in the Twenty-First Century (Cimino JJ in Methods Inf Med. 1998 Nov;37(4-5):394-403). SNOMED CT addresses these requirements and additional practical requirements for an implementable, globally applicable but locally extensible, multilingual solution.

### 3.1.2 Benefits for knowledge representation

Implementation of SNOMED CT within a knowledge resource, such as an electronic reference book, clinical guideline, decision support protocol, facilitates effective access from, or integration with, Clinical Information Systems.

The use of SNOMED CT in electronic health records enables consistent processable representation of clinical information. Potential uses of this information include linkage to knowledge sources to assist its understanding and interpretation.

Developers of decision support protocols, care pathways or data analysis packages can benefit by using SNOMED CT to represent requirements for clinical information collection and processing. This allows direct translation of the protocol into queries that can be applied directly to a SNOMED CT enabled electronic health record.

Publishers of knowledge based resources can benefit by tagging their information using SNOMED CT. These tags can be used to index information by concept rather than by keywords. As a result, relevant information can be identified by users during interaction with an electronic health record. For example, when selecting a particular item during data entry or review potentially relevant articles can be listed and/or displayed.
3.1.3 Benefits of an open global approach

Implementation of SNOMED CT offers the benefit of a global approach to the requirements for clinical terminology.

Any country or large organisation that is developing or deploying electronic health records needs to consider the requirements for consistent representation of clinical information. One element of the solution is usually a coding scheme, controlled vocabulary or terminology. The breadth or scope and depth of detail in clinical records means that the set of codes or terms required is large and grows rapidly as additional disciplines and specialties become involved. Similarly the interdependency of terms used in different domains leads to a significant level of complexity.

Developing and maintaining a terminology that adequately addresses clinical requirements is a substantial task. A global approach has significant benefits by enabling economies of scale for National bodies and health care service providers.

A global approach also encourages common solutions to some of the challenges posed by requirements for consistent representation of complex information. The resulting reduction in divergence provides a more secure foundation for implementers who wish to deploy their applications in many countries.

Implementing a global clinical terminology also enables applications to be deployed in other countries without needing to switch between terminologies. It also allows use of other standards and materials that incorporate or are designed for use with that terminology. The ability to integrate components and standards based on a common terminology is a major advance over solutions that depend on a local or proprietary code system.

A global clinical terminology also provides a foundation for communication and sharing of information. The information communicated may include clinical records used to support delivery of health care to a mobile population. It may also include aggregations of records used for epidemiology and multi-centre research.

3.1.4 Benefits of extensibility and configurability

Implementation of SNOMED CT allows common approaches to be applied to extend and configure the terminology for use in a particular environment.

Most clinical concepts are relevant in all countries, organisations and specialties but some concepts are relevant only to a particular environment. SNOMED CT allows national, local or organisational requirements to be addressed by separately maintained SNOMED CT Extensions. SNOMED CT enabled implementations can benefit from the content in these Extensions without the need for any additional software development because Extensions have exactly the same structure as the International Release.

SNOMED CT covers a broad domain to depth of detail appropriate to a range of health care disciplines and clinical specialties. As a result, it has an extensive content, different parts of which are needed in particular environments. The SNOMED CT design includes the Reference Set mechanism which provides a standard way to refer to a set of SNOMED CT components. Reference Sets can be used to configure different views of SNOMED CT by constraining searches or representing short lists of terms for a data entry field. They can also be used to meet other requirements including checking that a concept id falls within a permitted set of values for a field in a data structure or message (e.g. to represent an HL7 value set).

- Organisations implementing SNOMED CT benefit from Reference Sets because they allow requirements for use of particular terms and concepts to be represented in a form that can be applied to any SNOMED CT enabled application. This allows Reference Sets to be shared throughout and between organisations, even when different software is used to meet local or departmental requirements.
- Software developers and vendors benefit because Reference Sets provide a common, machine processable representation of requirements for different patterns of use of SNOMED CT. This simplifies local configuration and enhances interoperability with other SNOMED CT enabled applications.
3.2 Implementation Types

SNOMED CT itself is only a part of the solution to addressing the requirements for effective electronic clinical records. A terminology on its own "does" nothing unless it is implemented as part of an application and used. Implementation of SNOMED CT requires software applications that exploit its features to meet the real and perceived needs of users.

The "users" of SNOMED CT include:

- Those who specify, commission and configure software for use in a particular clinical environment;
- End-users who enter or retrieve clinical information.

As illustrated by Figure 1, users experience SNOMED CT through application software which delivers services to access and apply SNOMED CT. The ways in which applications apply the features of SNOMED CT to address user requirements determine the extent to which the potential benefits are realised.

The following sections summarise some of the types of implementation that may be needed to meet different requirements. Some types of application do not need to support or use all SNOMED CT features. However, there are some overarching requirements for consistency between implementation used within a given organisation, country or region. Even where requirements are limited, care should be taken to ensure that SNOMED CT enabled applications are aligned with good practise and with agreed policies applicable to the situations in which they are used.

![Figure 1: Relationship between users application software and SNOMED CT](image)

3.2.1 Implementation Types - Clinical records

A SNOMED CT enabled clinical record application uses SNOMED CT expressions to represent clinical information in the records of individual patients.
Clinical record applications include specialised departmental systems, organisation-wide systems and systems that integrate multiple systems to deliver a distributed electronic health record or a collection of widely accessible summary records.

A SNOMED CT enabled clinical record application needs to provide record services including entry, storage, retrieval and communication of SNOMED CT expressions. These record services depend on terminology services including the ability to search for concepts and to interpret stored SNOMED CT expressions.

A wide range of types of information can be represented at different levels of detail using SNOMED CT expressions. The types of information and level of detail that are used may vary depending on user requirement or may be limited by the design of the application. Differences in the required level of expressivity influence the range of record services that need to be supported.

The way that SNOMED CT expressions are represented within a record structure affects the range of services that are required to deliver the potential benefits of implementation. The value of the rich expressivity of SNOMED CT may be enhanced or diminished by the way the record structure relates SNOMED CT expressions to surrounding contextual information. For example, if a record structure permits similar or related information to be recorded in several ways a query to retrieve that information will need to consider all these possibilities. Retrieval is simpler if similar information is recorded in a consistent way - irrespective of the way it was entered. This issues are discussed in detail in the Record Services Guide (8).

3.2.2 Implementation Types - Knowledge representation

A SNOMED CT enabled knowledge representation uses SNOMED CT expressions to represent or tag resources that represent clinical knowledge. Examples of resources that can be SNOMED CT enabled include electronic reference books, clinical guidelines, care pathways, decision support protocols and requirements for analysis and audit.

There are various ways in which SNOMED CT expressions can be used in a knowledge resource. These can be divided into two broad categories:

- **Use of SNOMED CT expressions as an integral part of a structured representation of knowledge:**
  - For example, a decision support rule that tests for the existence of a record of a particular type of finding represented using a SNOMED CT expression.

- **Use of SNOMED CT expressions to tag or index a knowledge resource:**
  - For example, a reference book in which textual descriptions of indications, contraindications and side effects of particular treatments are tagged with SNOMED CT expression that can be used to allow context-sensitive retrieval of relevant information.

There are two distinct but interrelated aspects to SNOMED CT knowledge representation.

- **Applying SNOMED CT expressions to the resource:**
  - The form of representation to be used must be specified in a way that takes account of the ways in which the resource is to be used and accessed.
  - The knowledge authoring environment must allow the specified representation to be applied consistently. This requires use of Terminology services that allow searching and selection of concepts. Depending on the level of detail required, there may also be a requirement to support the construction of postcoordinated expressions.

- **Enabling appropriate access to and use of the resource:**
  - The types of access required depend on the intended functionality.
  - The most basic level of functionality involves using SNOMED CT expressions as a concept-based index. By taking account of the SNOMED CT subtype hierarchy and defining relationships, a concept-based index can provide more relevant results than a simple term-based search.
  - More sophisticated uses such as clinical decision support require SNOMED CT expressions in the knowledge resource to be used to generate queries that can be applied to information stored in an electronic health record.
• The provider of a SNOMED CT enabled knowledge resource may provide a specification that allows software developed by other organisations to interrogate it and provide the required level of functionality. Alternatively, the knowledge authoring organisation may also develop and provide software that delivers the intended functionality.

3.2.3 Implementation Types - Aggregation and analysis

SNOMED CT enabled aggregation and analysis systems use SNOMED CT to enable effective aggregation and analysis of information derived from clinical record systems.

SNOMED CT enables consistent processable representation of clinical information. As well as presenting opportunities for analysis of information within an individual clinical record system, this can be used to support analysis of a broader substrate of aggregated data.

There are two types of approach that be employed to enable analysis of aggregate data.

• A SNOMED CT enabled data warehouse:
  • The content and structure of data required from individual Clinical Information Systems is specified. The specified structure must include details of the required representation of data including SNOMED CT expressions.
  • The required data is extracted and uploaded to a database designed for the purpose of large scale analysis. Usually the extract and upload will need to be repeated or updated at specified intervals.
  • The central database is structured to optimise common types of queries taking account of the SNOMED CT expressions and the relationships between referenced concepts asserted in SNOMED CT content.
  • A query interface is provided to allow common types of question to be expressed against the central database.
  • Queries are run taking account of the relationships between concepts to provide comprehensive and accurate results (minimising the risks of false negatives or false positives).
  • The results of queries are presented where relevant using SNOMED CT expressions as processable labels to enable further analysis.

• A common query specification supported by clinical record systems:
  • A common reference information model including SNOMED CT expressions is specified. This is used as a common model of meaning against which queries are evaluated.
  • Each clinical record system provider implements this common model of meaning as a view of the information stored in their electronic health record.
  • A query interface is provided to allow common types of question to be expressed against the common model of meaning.
  • Queries are distributed and run on individual systems and the results are returned to a central system for aggregate reporting.
  • The results of queries are presented where relevant using SNOMED CT expressions as processable labels to enable further analysis.

In practise, there is significant overlap between these two approaches. A data warehouse approach can benefit from a common approach to specifying the information extraction requirements. This allows changes to the specification without re-engineering the contributing clinical record systems. A common query specification approach requires a central element to manage distribution of queries and aggregation of results.

Irrespective of the approach taken, SNOMED CT enabled aggregation and analysis is most effective where the representation of information in the contributing clinical record systems is consistent with a common view. However, it is possible to aggregate information from diverse systems if the limits imposed by differences are understood. It is even possible for a SNOMED CT aggregation and analysis system to be applied information that was not originally encoded using SNOMED CT. An extraction and aggregation interface that includes mapping from another coding system may produce information of adequate quality and consistency for many purposes. Data derived by tagging textual records using natural language processing may also meet requirements that are not safety-critical.
3.2.4 Terminology tools

**SNOMED CT enabled terminology tools** provide access to **SNOMED CT** content. On their own they are not practical end-user implementations but they enable the development and review of **SNOMED CT**. They may also deliver services that can be used by end-user implementations.

### 3.2.4.1 Implementation Types - Terminology browser

A **SNOMED CT enabled browser** allows the content and structure of **SNOMED CT** to be explored and reviewed.

A typical **SNOMED CT enabled browser** can locate **concepts** and **descriptions** by **Identifiers** and by searching the text of **description terms**. Various views of located **concepts** may be displayed including the set of related **descriptions**, the hierarchical **relationships** and other defining **relationships**.

A terminology **browser** may be:

- A stand-alone tool.
- Part of a more extensive implementation.
- Accessible via an **Application Programming Interface (API)**:
  - This may allow the **browser** to be used by client applications to select **SNOMED CT expressions**;
  - It may be part of a **terminology server** which provides a wider range of **Terminology services**.

### 3.2.4.2 Implementation Types - Terminology server

A **SNOMED CT enabled terminology server** is a software application that provides programmatic access to **SNOMED CT components**. These services are made available through a documented **Application Programming Interface (API)** which can be used by many different client applications.

A **SNOMED CT enabled terminology server** must be able to import **SNOMED CT release files** and provide some or all of the services described in the **Terminology Services Guide** (7). All terminology servers must support a basic minimum set of functions including **Foundation Terminology Services** and access to **Reference sets and other metadata**.

A terminology **server** may provide **user interface** services, such as a set of screen controls to support term selection. Alternatively, while the API should support searches, the user interface representation of the results of a search may be left to client applications. Where user interface controls are provided by the server, these controls may also be packaged in an integrated form as a **terminology browser**.

A **SNOMED CT enabled terminology server** may also provide services that support the use of other terminologies. In this case, it may conform to a standard specification such as **Common Terminology Services 2 (CTS2)**.

### 3.2.4.3 Implementation Types - Terminology development and maintenance tools

**SNOMED CT** development and maintenance requires tools which are able to create and update **SNOMED CT** content.

Development and maintenance tools may either be general purpose or may focus on specific requirements (e.g. **Reference Sets** to support **language**, **mapping** or development of **value sets**).

The process of maintenance needs to track changes and manage conflicts between edits made by different authors. In the case of content development, the tools must also ensure that **concept definitions** conform to the **SNOMED CT Concept Model**. At regular intervals the tools need to generate a consistent set of quality assured **release files**.

The **IHTSDO Workbench** is a set of software tools designed to support the development, maintenance, and use of **SNOMED CT**. Its key role is to facilitate the maintenance of the **SNOMED CT International Release** and the National Extensions developed by **IHTSDO Members**. However, the future scope of use may extend to other organisations and to health information systems around the world. The **Workbench** is owned by the **IHTSDO** and is available under an Open Source licence agreement.
3.3 Implementation Levels

SNOMED CT can be implemented in a wide range of clinical record applications. These include systems developed for use with other code systems that have been adapted to support SNOMED CT as well as systems designed with the assumption that SNOMED CT would serve as the primary terminology. The SNOMED CT features that applications support and use may vary, partly due to differences in user requirements and partly due to development priorities. Against this background of variability, it is reasonable to ask what is a SNOMED CT implementation or what is a good SNOMED CT implementation. While there is not a single or simple answer to these questions, this section identifies some key dimensions which determine the capability of SNOMED CT enabled clinical record systems.

Each of the following sections describes a dimension and outlines a spectrum of capabilities ranging from absence of support (Level 0) to full support (Level 2). A mixture of Level 0 and Level 1 capabilities are likely to be found in existing systems that have been adapted to work with SNOMED CT. A system specifically developed to work with SNOMED CT should be expected to have capabilities that are at least at the high end of the Level 1 spectrum and should ideally have Level 2 capabilities.

The specification of different levels is not intended to suggest a step-by-step development path. Those needing to rapidly SNOMED CT enable an existing clinical record system are recommended to follow a two stage approach.

1. Design, develop and deploy a revision to the current system to support Level 1 capabilities that meet known short or medium term requirements:
   - The level achieved in this stage will depend on customer requirements and the design limitation of the existing system.

2. Design and develop a new or substantially revised system (including revised record structures) to support a mixture of high-end Level 1 and Level 2 capabilities:
   - The level at which this development is target should be one that meets anticipated medium to long term requirements;
   - Even if the initial target of the work is limited to the high-end of Level 1, the design should be sufficiently flexible to enable Level 2 capabilities to be added when required.

Developers who do not require a rapid deployment based on a revision of an existing systems are recommended to skip the first step and proceed to design and develop a flexible solution that utilises the key strengths of SNOMED CT.

Each of the following sections describes one dimension that contributes to the overall implementation level. It is important to recognise that:

- This is not a formal scoring scheme;
- Some dimensions are more significant than others;
- The significance of reaching a particular level depends on the nature of the application and the user requirements it seeks to address.
- Many of the dimensions are inherently interdependent:
  - For example, Level 2 data entry capabilities are not compatible with Level 1 data storage.

3.3.1 Implementation Level - Scope of use

A clinical record system may use SNOMED CT expressions to represent some or all of the types of information outlined in the list below. The types of information for which SNOMED CT can be used may be limited by the structure used to store the electronic health record. The significance of these limitations depends upon the intended use of the clinical record system.

- Level 0: No support for SNOMED CT expressions.
- Level 1: Support for use of SNOMED CT limited to particular types of clinical data:
• Addressing the requirements for a particular type of use;
• Addressing a set of requirements specified by a particular organisation.

• Level 2: Support for consistent use of SNOMED CT across a broad scope of information types:
  • Providing a general purpose approach to the use of SNOMED CT within an electronic health record
  • Allowing configuration to vary the scope of coverage to meet specific requirements.

The following check-list identifies some of the electronic health record elements in which SNOMED CT expressions might be used. The list is not complete but it covers many of the areas in which use of SNOMED CT has been discussed in IHTSDO working groups. It is intended to assist consideration of the areas in which SNOMED CT should be used to meet the needs of users and organisations. The inclusion of an item in this list does not imply that the SNOMED CT International Release provides comprehensive content to populate that part of the record.

1. Disorders, diagnoses and problems:
   • Problem list entries;
   • Admission diagnosis;
   • Discharge diagnosis;
   • Provisional or working diagnosis;
   • Differential diagnosis.

2. Symptoms:
   • Presenting symptoms;
   • History of current condition;
   • Other symptoms.

3. Allergies and adverse reactions:
   • Adverse reaction events;
   • Allergies and other propensities to adverse reactions.

4. Procedures:
   • Operative procedures.
   • Diagnostic procedures.
   • Medications:
     • Current medication;
     • Prescriptions;
     • Dispensing records;
     • Drug charts.
   • Other therapeutic procedures:
     • Other therapy requests;
     • Other therapy delivery and outcomes.

5. History:
   • Medical and surgical past history;
   • Medication history;
   • Family history.

6. Examination findings:
   • Vital signs;
   • Clinical examination findings.

7. Investigation information:
   • Laboratory investigations:
• Laboratory investigation requests;
  • Laboratory investigation procedures;
  • Laboratory investigation results.

• Diagnostic imaging:
  • Diagnostic imaging requests;
  • Diagnostic imaging procedures;
  • Diagnostic imaging results.

• Other investigations:
  • Other investigation requests;
  • Other investigation procedures;
  • Other investigation result.

8. Other types of clinical information:
  • Planned actions;
  • Risk, goal and expected outcomes;
  • Scale based assessments;
  • Progress notes.

9. Administrative information:
  • Admission, transfer and discharge events.

10. Other values:
  • Body sites, structures and locations;
  • Organisms;
  • Substances (other than drugs);
  • Pharmaceutical and biological products (drugs).

3.3.2 Implementation Level - Record structure

The logical model underlying the structure of the record has a direct effect on the ability of a SNOMED CT enabled clinical record system to take advantage of the features of SNOMED CT. An application may use an optimised proprietary internal representation of the electronic health record. However, consistent use of SNOMED CT across a range of applications requires a common reference model to which proprietary structures are mapped. In addition to this, the ways in which SNOMED CT expressions are used within a common reference information model need to be constrained to improve predictability and minimise ambiguity.

• Level 0: A proprietary structure that is neither aligned with nor mapped to a standard reference information model:
  • Low: Text only record with no use of clinical codes;
  • High: Structured record supporting use of clinical codes.

• Level 1: A structure that is aligned with or mapped to a standard reference information model:
  • Low: Proprietary structure mapped to a standard model to support limited messaging requirements. Supports the use of SNOMED CT coding within that structure.
  • High: Structure aligned with a standard reference information model that supports that supports use of SNOMED CT coding.

Examples of standard reference information models include:
  • The HL7 Version 3 Reference Information Model (RIM);
  • The CEN TC251 Health informatics - Electronic health record communication - Part 1: Reference model (EN13606).
• Level 2: An aligned or mapped structure in which SNOMED CT expressions are used in accordance with agreed guidelines for use of a standard reference information model:

• In Level 2 SNOMED CT is used in accordance with terminology binding guidance to minimise the semantic gaps and overlaps between the terminology and the information model. Without constraints, these gaps and overlaps lead to inconsistent representation of similar data and thus limit the effective reuse of information.

• Example of agreed guidelines for using use of SNOMED CT expression in particular reference models include:
  • The HL7TermInfo DSTU - Guide to the Use of SNOMED CT in HL7 Version 3;
  • Guidance on terminology binding developed by the UK NHS Logical Record Architecture for use in an EN13606 based logical model.

3.3.3 Implementation Level - Expression storage

Support for storing precoordinated and postcoordinated SNOMED CT expressions determines the extent to which SNOMED CT can be used to represent detailed information within an electronic health record.

• Level 0: No support for storage of SNOMED CT expressions

• Level 1: Support for storage of precoordinated SNOMED CT expressions:
  • Support for storage of a precoordinated expression implies the ability to store a representation of a concept identifier as part of each item for which SNOMED CT is used:
    • The concept identifier may be represented as a 64-bit integer or as an 18-digit string;
    • Other internal representations may be used provided they can be resolved to the appropriate Identifier for display, communication or processing.

• Level 2: Support for storage of postcoordinated SNOMED CT expressions:
  • Support for storage of a postcoordinated expression implies the ability to store a representation that captures the logical model of a postcoordinated expression:
    • The simplest representation of a postcoordinated expression is the SNOMED CT compositional grammar. Due to the open-ended nature of postcoordinated expressions, this representation results in a string of variable length with no clear-cut maximum length.
    • The guide discusses alternative representations including the use of expression reference table which enables use of a fixed length reference within the records. This approach uses a UUID which can be represented as a 128-bit integer or as a hexadecimal string (see Storing expressions).
  • This level has variants depending on the extent of support for postcoordinated expression storage:
    • Low: Storage of postcoordinated expressions limited to specific fields in the record structure;
    • High: Full support for storage of postcoordinated expression allowing any valid expression to be stored and retrieved.

3.3.4 Implementation Level - Data entry

The categorisation in this section is based on the extent to which the system enables entry of SNOMED CT expressions. In addition, this section indicates the importance of a well-designed user-interface.

• Level 0: No support for entry of SNOMED CT expressions.

• Level 1: Support for precoordinated SNOMED CT expression entry:
  • Low: Access limited to fixed set of SNOMED CT concepts;
  • Medium: Access to full content of SNOMED CT;
• High: Access to full content of SNOMED CT with configurable value sets matched to user requirements.

• Level 2: Support for postcoordinated expression entry:
  • Low: Access to limited postcoordination (matching data storage restrictions);
  • Medium: Access to full range of postcoordination supported by the Concept Model;
  • High: Access to postcoordination with configurable constraint matched to user requirements.

Another important data entry issue is the ease of use which depends on the usability, relevance and performance of searches. Where postcoordinated data entry is supported the approach to selecting or constructing postcoordinated expressions is also significant.

An attempt to categorise specific approaches to the user-interface is subjective as alternative user interfaces may be appropriate to different uses. However, for most environments a flexible range of configurable SNOMED CT aware user-interface tools is likely to offer a better user experience than reliance on a one-size fits all browser or search engine.

3.3.5 Implementation Level - Data retrieval

A major strength of SNOMED CT is its ability to support meaning based selective retrieval. The extent to which this feature is used by a clinical record system determines the value of entering and storing the data.

• Level 0: No native support for SNOMED CT enabled data retrieval:
  • This level has variants depending on whether it can map code in exported data to SNOMED CT expressions:
    • Low: No support for SNOMED CT based analysis;
    • High: Support for extracting a specified set of locally coded data and mapping the local codes to appropriate SNOMED CT expression for central aggregation and analysis.

• Level 1: Support for retrieval of precoordinated SNOMED CT expressions:
  • This level has a spectrum of variants depending on the level of support for the following features:
    • Query expressivity: The ability to express query predicates that explicitly include or exclude subtypes of specifically identified concepts;
    • Subsumption testing: Use of SNOMED CT subtype hierarchy to interpret and evaluate queries;
    • Concept Equivalence: The ability to retrieve equivalent information even if it is represented in different structures within the record;
    • Context awareness: The ability to take account of contextual information, derived from the record structure and/or the SNOMED expression, when interpreting and evaluating queries;
    • Performance: The ability to interpret and evaluate queries within an appropriate period of time and without causing deterioration in other system functions.

• Level 2: Support for retrieval of postcoordinated SNOMED CT expressions:
  • This level has a spectrum of variants depending on the level of support for the following additional aspects of the features specified for Level 1:
    • Query expressivity: The ability to represent postcoordinated predicates in a query;
    • Subsumption testing: Use of defining characteristics and normal form transformations (or a description logic classifier) to determine whether expressions are subsumed by query predicates;
    • Equivalence: Use of defining characteristics and normal form transformations (or a description logic classifier) to determine equivalence between different postcoordinated expressions and in different structures within the record;
    • Context awareness: The ability to take account of contextual information derived from the record structure and/or postcoordinated SNOMED expressions, when interpreting and evaluating queries;
• Performance: The ability to interpret and evaluate queries that support postcoordinated representations within an appropriate period of time and without causing deterioration in other system functions.

3.3.6 Implementation Level - Communication

The ability to send and received SNOMED CT expressions in messages or other communication is partially dependent on data entry, storage and retrieval capabilities. However, some types of communication may be supported by mapping or human-readable renderings even in the absence of internal support for SNOMED CT.

• Level 0: Mapping based support for communication of SNOMED CT expressions:
  • Inbound communications containing SNOMED CT expressions:
    • Low: Not supported.
    • Medium: Rendered as human-readable text. Unless the inbound message also contains the term text, this requires access to some SNOMED CT enable Terminology services to lookup and display the relevant terms.
    • High: Mapped to an internal coding scheme or classification. This may be feasible to support specific use cases but not for the full scope of clinical information.
  • Outbound communication containing SNOMED CT expressions:
    • Low: Not supported;
    • Medium: Supported for a few specific types of clinical data in the existing system by mapping to from an existing code system to SNOMED CT;
    • High: Supported for most clinical data in the existing system by mapping to from an existing code system to SNOMED CT.

• Level 1: Native support for communication of precoordinated SNOMED CT expressions:
  • Inbound communications containing precoordinated SNOMED CT expressions:
    • Low: Supported for some types of information but constrained by data entry and expression storage capabilities;
    • High: Supported for most types of information.
  • Outbound communications containing precoordinated SNOMED CT expressions:
    • Low: Supported but limited by data entry and storage and retrieval capabilities;
    • High: Supported for most types of information.

• Level 2: Native support for communication of postcoordinated SNOMED CT expressions:
  • Inbound communications containing postcoordinated SNOMED CT expressions:
    • Low: Support limited to particular attributes (e.g. [laterality], [causative agent]) in postcoordinated expression;
    • Medium: Support for general postcoordination applied to some types of information;
    • High: Able to receive, process and store any valid postcoordinated expression.
  • Outbound communications containing postcoordinated SNOMED CT expressions:
    • Low: Support limited to particular attributes (e.g. [laterality], [causative agent]) in postcoordinated expression;
    • Medium: Support for outbound communication of any postcoordinated expression that can be entered or stored in the system;
    • High: Support for outbound communication of any valid postcoordinated expression.
3.4 Implementation Services

When designing or implementing a SNOMED CT enabled application, the first step is to assess the range of services necessary to meet user requirements. The two main categories of services required by applications are terminology services that only interact with the terminology and record services which apply the terminology to instance data. These services are described in separate sections of this guide.

The Terminology Services Guide (7) describes services that access SNOMED CT reference data. These services are summarised in Figure 2.

![Figure 2: SNOMED CT Enabled Terminology services](image)

The Record services guide (8) describes services that apply SNOMED CT to represent information in a clinical record. These services are summarised in Figure 3.
3.4.1 Service architecture

A SNOMED CT enabled application may be completely self-contained, delivering all the required services as part of a single development. Alternatively, service delivery may be modularised so that separately developed reusable modules are used to meet specific sets of requirements.

A distinction can be made between functions that only require interaction with terminology resources (terminology services) and functions that involve using the terminology as part of an application such as an electronic health record (record services).

Terminology services can be generalised, so that they are independent of the way the terminology is used in a particular clinical record application. Terminology services include support for the following types of function.

- **Read-only functions:**
  - Importing and updating a local terminology repository with a SNOMED CT release;
  - Determining the properties or an identified component;
  - Text or pattern searches for Descriptions that include a matching term;
  - Displaying a part of the concept hierarchy;
  - Determining whether a SNOMED CT concept or expression is equivalent to or a subtype of another concept or expression;
  - Locating the map from a particular SNOMED CT concept to a code in another scheme or classification.

- **Authoring and maintenance functions:**
  - Enabling the creation and maintenance of core SNOMED CT components to facilitate production of the SNOMED CT International Release and Extensions to SNOMED CT;
- Enabling the creation and maintenance of derivative such as reference sets to customise and enhance the effective use of SNOMED CT.

**Record services** are intimately related to ways in which information is entered, stored and retrieved by a particular application. Therefore, while these services interact with terminology services they are usually specific to a particular application or to a family of applications with a common underlying record design. **Record services** include support for the following types of function:

  - **User interface** functions that:
    - Enable entry of information using SNOMED CT expressions where these are relevant;
    - Display of previously entered information, with appropriate rendering of SNOMED CT expressions;
    - Enable design of protocols that guide data entry to encourage efficient and consistent use of SNOMED CT;
    - Enable specification of queries that include appropriate use of SNOMED CT to meet requirements for selective retrieval.

  - **Application server functions that**:
    - Store SNOMED CT expressions as part of the individual record entries (or in other types of instance data);
    - Communicate data including SNOMED CT expressions in ways dictated by standards and local specifications;
    - Apply queries to efficiently, accurately and precisely retrieve information taking account of the data structure of the application and the logical **Relationships** between SNOMED CT expressions.

These two sets of services can be developed and provided separately. This approach allows record service to access required terminology services through an Application Programming Interface (API). The guide does not specify an API but, by making a clear distinction between terminology services and record services, it identifies the functions that such an interface should support.

Self-contained and modular approaches offer different profiles of advantages, some of which are summarised below.

- A modular approach offers the following advantages:
  - Rapid development of SNOMED CT related functionality, focused on meeting the requirements of users of a specific software application.
  - Opportunities to choose between different terminology servers to deliver a cost-effective solution.
  - Simplifies future migration to enhanced or more cost-effective solutions by separately identifying reusable and replaceable modules.
  - Allows several applications used by a single organisation to use a single terminology server. This has several advantages:
    - Reduction of maintenance and support cost associated with installing each release of SNOMED CT;
    - Guaranteed alignment of SNOMED CT releases between applications that share the server;
    - Consistency of the user interface and technical characteristics of different applications with respect to their access to SNOMED CT.

- A fully integrated approach offers the following advantages:
  - Independence of third party development;
  - Customised access to SNOMED CT tailored to the needs of particular application users.

The approach chosen depends on a careful consideration taking into account the cost and functionality of available components. Commercial and technical concerns about dependence on third-party components may be a valid reason for in-house development of all the required services. However, even where all the development is undertaken within a single organisation, separation of terminology and record services into separate components may offer a more robust approach, allowing future extensibility and migration at lower cost.
Chapter 4

4 Structure and Content Guide

This part of the guide covers the features of SNOMED CT that need to be understood by those implementing SNOMED CT in software applications. These features include the components, derivatives and supporting materials that are distributed as part of each SNOMED CT Release. In addition, the guide addresses the ways in which these components may be referenced to represent instances of clinical information in clinical records and other types of instance data.

4.1 SNOMED CT Technical Overview

This section provides an overview of the components and derivatives that form part of a SNOMED CT release as well as several other topics that relate to the use of SNOMED CT to represent instances of clinical information.

These topics are explored in more depth by other sections in this part of the guide:

- Logical Abstract Models;
- Representational Forms.

More detailed information about technical design and content is provided in other parts of the guide:

- Release File Specifications (5);
- Concept Model Guide (6).

4.1.1 Components

This section summarises the essential components of SNOMED CT (concepts, descriptions and relationships). A SNOMED CT enabled implementation must be able to process and make appropriate use of these components, which are distributed as a set of Release Files (5).

4.1.1.1 Concepts

A SNOMED CT Concept is a clinical idea to which a unique SNOMED CT identifier has been assigned.

Each Concept is associated with:

- A unique human-readable Fully Specified Name (FSN), which specifies the meaning represented by the Concept.
- A set of other Descriptions, each of which represents the same Concept using a different human-readable term. These Descriptions support alternative representations such as synonyms and translations into different languages.
- A set of Relationships to other Concepts which provide a logical definition of the Concept that can be processed by a computer.

4.1.1.1.1 Concept Identifiers

Each SNOMED CT Concept has a permanent unique numeric Identifier which is known as the Concept Identifier.
The sequence of digits in a Concept Identifier does not convey any information about the meaning or nature of the Concept\(^1\). The meaning of Concept is represented in human-readable forms by Descriptions and in a computer processable form by Relationships with other Concepts.

The advantages of meaningless Identifiers include:

- **Identifier permanence without undermining interpretation:**
  - In contrast, to maintain consistency, a meaningful code may need to change to reflect revised understanding of the nature of a disorder.

- **Enabling multiple aspects of meaning to be represented in the same way:**
  - A meaningful code can only represent part of meaning of a complex concept. For example, [staphylococcal pneumonia] is an [infection], a [respiratory disorder] and a [disorder] caused by [staphylococcus] but only one of these aspects can be represented by a code based hierarchy. Thus in the 'J' in the ICD-10 code 'J152: Pneumonia due to staphylococcus' represents that fact that this is a respiratory disorder but does not represent the fact that it is an infection (codes starting with 'A') or that it is due to staphylococcus ('A490: Staphylococcal infection, unspecified').

- **No artificial limitation on concept granularity:**
  - Typical approaches to meaningful coding impose limits on both the number of levels of specificity (i.e. the length of the code) and the number of options at each level (i.e. the number of different symbols that can be used in each character position).

### 4.1.1.1.2 Concept granularity

The meaning represented by a Concept can be general (for example | procedure |), specific (for example | excisional biopsy of lymph node |) or somewhere in between (for example | biopsy of lymph node |).

- **More specific Concepts:**
  - Have finer granularity (more granular);
  - Represent clinical detail.

- **More general Concepts:**
  - Have coarser granularity (less granular);
  - Represent less clinical detail;
  - Aggregate similar Concepts.

Support for multiple levels of granularity allows SNOMED CT to be used to represent clinical data at a level of detail that is appropriate to a range of different uses.

Concepts with different levels of granularity are linked to one another by | is a | relationships. This enables appropriate aggregation of specific information within less detailed categories.

---

\(^{1}\) The use of meaningless identifiers differs from the approach taken by some other coding systems and classifications. For example, the first character of an ICD-10 code indicates the general classification that it falls within.
4.1.1.2 Descriptions and Terms

Terms are character strings that consist of words, phrases and other human-readable representations that convey the meanings of concepts. A term in connection to a particular concept is called a description.

Each description has a description type and may be marked a preferred for use in particular languages or dialects. There are two commonly used description types, Fully Specified Name (FSN) and Synonym. A Synonym that is marked as preferred for use in a particular language or dialect is preferred to as a Preferred Term. A description may be a Preferred Term in one dialect and a synonym in another dialect. This is indicated by references to the description from the Language Reference Set for that language or dialect.

- Each description associates a human-readable term with one concept.
- A concept has several associated descriptions.
- Each description has a unique Description Identifier and is distributed as a row in the Description File.

4.1.1.2.1 Fully Specified Name

Each concept has at least one Fully Specified Name (FSN) intended to provide an unambiguous way to name a concept. The purpose of the FSN is to uniquely describe a concept and clarify its meaning. The FSN is not a commonly used term or natural phrase and would not be expected to appear in the human-readable representation of a clinical record.

A concept may have more than one FSN, but only one of these may be marked as preferred in a given language. A Language Reference Set is used to specify which FSN descriptions is preferred in each language or dialects. The original fully specified name (the first FSN created for a concept) is the ultimate source of reference, if FSNs in different languages have conflicting meanings. Most original FSNs are in US English and, as many translators choose not translate FSNs, the original FSN is preferred by default.

Note: The term in each FSN is unique across the entire active content of a SNOMED CT release.
Each FSN term ends with a “semantic tag” in parentheses. The semantic tag indicates the semantic category to which the concept belongs (e.g. clinical finding, disorder, procedure, organism, person, etc.). The “semantic tag” helps to disambiguate different concepts which may be referred to by the same commonly used word or phrase.

**Example:** | Hematoma (morphologic abnormality) | is the FSN of the concept that represents the “hematoma” that a pathologist sees at the tissue level. In contrast, | Hematoma (disorder) | is the FSN of the concept that represents the clinical diagnosis that a clinician makes when they decide that a person has a “hematoma”.

### 4.1.1.2.2 Synonym

A synonym represents a term, other than the FSN, that can be used to represent a concept in a particular language or dialect.

Each concept one or more descriptions of type synonym in each language. A description of type synonym contains a term that represents a word or phrase, other than the term in the fully specified name that can be used to represent a concept. One synonym for each concept is marked as preferred in each dialect and the associated term is called the preferred term for that concept.

The use of a description can vary between different languages, dialects and contexts, so a description may be preferred in some dialects, acceptable for use in other dialects and may not used in some dialects. A Language Reference Set is used to specify the descriptions that are acceptable or preferred in each language or dialect.

**Example:** Synonyms of the concept 22298006 | myocardial infarction (disorder) | in English include:

- | cardiac infarction | (Description.id: 37442013);
- | heart attack | (Description.id: 37443015);
- | infarction of heart | (Description.id: 37441018);
- | myocardial infarction | (Description.id: 37436014).

The synonym | myocardial infarction | (Description.id: 37436014) is marked as preferred in the US English Language Reference Set. Thus in US English this is the preferred term.

**Note:** Unlike fully specified names, synonyms are not required to be unique.

### 4.1.1.2.3 Preferred Term

The preferred term is the preferred common word or phrase used by clinicians to name that concept in a particular language, dialect or context. Each concept has one to more descriptions of type synonym in each language. In each language or dialect one of these description is marked as preferred and is the preferred term for that concept.

The use of a description can vary between different languages, dialects and contexts, so a description may be preferred in some dialects, acceptable for use in other dialects and may not used in some dialects. A Language Reference Set is used to specify the descriptions that are acceptable or preferred in each language or dialect.

**Example:** The concept 54987000 | repair of common bile duct (procedure) | has a description of type synonym | choledochoplasty |. This is marked as preferred in the US English Language Reference Set. Therefore, | choledochoplasty | is the preferred term for this concept in US English.

**Note:** Unlike the fully specified name (FSN) the preferred terms need not be unique. Occasionally, the preferred term for one concept may also be a synonym for a different concept. Interpretation in these cases will depend on context of use.

**Example:**

- | Cold sensation quality (qualifier value) | has a preferred term of “Cold”;
- | Common cold (disorder) | also has a synonym of “Cold”.

In both cases, “cold” represents a common clinical phrase used to capture the meaning of the concept.
Note: Selection of one term over another as “preferred” in a given language dialect depends entirely on whose preferences are being expressed. Different users are likely to have different preferences, and implementers are encouraged to select terms that properly represent the concept and meet the preferences of users. There is no expectation that the preferred term distributed with a given language dialect will meet all use cases; nor is there anything sacrosanct about the term. The US English preferred term has no special status relative to other terms. Rather, it is merely one term that properly represents the concept and can be used as a starting point.

4.1.1.3 Relationships

A Relationship represents an association between two Concepts.

Each Relationship is identified by a unique Relationship Id and is distributed as a row in the relationship file.

A Relationship contains Identifiers of two logically associated Concepts and the Identifier of another Concept that indicates the Relationship Type by which they are associated.

Table 5: Example: Defining arthritis as a type of joint disorder

<table>
<thead>
<tr>
<th>Relationship.id</th>
<th>sourceld</th>
<th>typeld</th>
<th>destinationld</th>
</tr>
</thead>
<tbody>
<tr>
<td>2227469024</td>
<td>3723001</td>
<td>116680003</td>
<td>399269003</td>
</tr>
<tr>
<td>In human readable terms</td>
<td>arthritis</td>
<td>is a</td>
<td>joint disorder</td>
</tr>
</tbody>
</table>

4.1.1.3.1 Relationships and concept definitions

Each concept in SNOMED CT is logically defined through its relationships to other concepts.

Every active SNOMED CT concept (except the SNOMED CT Concept Root concept) has at least one | is a | relationship to a supertype concept.

| is a | relationships and defining attribute relationships are known as the defining characteristics of SNOMED CT concepts. They are considered defining because they are used to logically represent a concept by establishing its relationships with other concepts. This is accomplished by establishing | Is a | relationships with one or more defining concepts (called supertypes) and modeling the difference with those supertypes through defining attributes.

Example: | Fracture of tarsal bone (disorder) | is defined as:

- | is a | subtype of | Fracture of foot (disorder) |
- and has | finding site | | Bone structure of tarsus (body structure) |
- and has | associated morphology | | Fracture (morphologic abnormality) |

Note: A relationship is assigned only when that relationship is always known to be true.

Example: Group A Streptococcus causes most cases of Streptococcal pharyngitis. However, a small percentage of these cases are caused by other species of Streptococcus. Therefore, it would be incorrect to define | Streptococcal sore throat (disorder) | as having | causative agent | | Streptococcus pyogenes (organism) |. Instead it is correctly defined as having the more general | causative agent | | Genus Streptococcus (organism) |.

4.1.1.3.2 IS A Relationships

| is a | relationships are also known as “Supertype - Subtype relationships” or “Parent - Child relationships”. | is a | relationships are the basis of SNOMED CT's hierarchies, as illustrated below.
Figure 5: Example IS A hierarchy

A concept can have more than one is a relationship to other concepts. In that case, the concept will have parent concepts in more than one sub-hierarchy of a top-level hierarchy. Subtype relationships can be multi-hierarchical.

Figure 6: Example IS A Relationships

4.1.1.3.3 Attribute Relationships

An attribute relationship is an association between two concepts that specifies a defining characteristic of one of the concepts (the source of the relationship). Each attribute relationship has a name (the type of relationship) and a value (the destination of the relationship).

The combination of the attribute relationships and is a relationships associated with a concept represent the logical definition of that concept. Therefore, the logical concept definition includes one or more supertypes (represented by is a relationships), and a set of defining attributes that differentiate it from the other concept definitions.

Example:

Since pneumonia is a disorder of the lung, the logical definition of the concept Pneumonia (disorder) in SNOMED CT includes the following relationship. The Attribute Finding site is assigned the value Lung structure (body structure).

• Finding site = Lung structure (body structure)

The full definitions of the concepts Pneumonia (disorder), Infective pneumonia (disorder) and Bacterial pneumonia (disorder) are shown below. Each line represents a defining Attribute with a value.

• is a = pneumonitis
• , is a = lung consolidation
• , { associated morphology = inflammation
• is a | consolidation

**Figure 7: Definition of Pneumonia (disorder)**

• is a | infectious disease of lung
• is a | pneumonia
• pathological process | infectious process
• associated morphology | inflammation
• associated morphology | consolidation
• finding site | lung structure

**Figure 8: Definition of Infective pneumonia (disorder)**

• is a | bacterial lower respiratory infection
• is a | infective pneumonia
• causative agent | bacteria
• pathological process | infectious process
• associated morphology | inflammation
• associated morphology | consolidation
• finding site | lung structure

**Figure 9: Definition of Bacterial pneumonia (disorder)**

*Figure 10* illustrates some of these *Relationships* graphically. *Relationships* relate a concept to more general concepts of the same type. In contrast, *Attribute Relationships* (such as | Finding site | and | Causative agent |) relate a concept to relevant values in other branches of the *subtype hierarchy*.

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**Figure 10: Illustration of Defining Relationships**
4.1.1.4 Common Features of Components

This section describes common features of all SNOMED CT Components including identification and history management.

4.1.1.4.1 Component features - History

The content of SNOMED CT evolves with each release. The types of changes made include new Concepts, new Descriptions, new Relationships between Concepts and new Reference Sets, as well as updates and retirement of any of these components. Drivers of these changes include changes in understanding of health and disease processes; introduction of new drugs, investigations, therapies and procedures; and new threats to health, as well as proposals and work provided by SNOMED CT users.

Once released, the unique Identifiers of SNOMED CT components are persistent, and their Identifiers are not reused. When a component becomes inactive this is indicated by the value of the active field, which is present in all components. Components continue to be distributed even when they are no longer active. This allows a current release to be used to interpret data entered using an earlier release.

Since the implementation of Release Format 2 (RF2), all changes in components are represented in the corresponding files, by adding a new row, with the same component ID, a new effective time and any necessary change in the component values.

The Component Inactivation Reference Sets are used to indicate the reason for inactivating a component. These reasons include errors, duplication of another component and ambiguity of meaning, and the files are used to describe reasons for inactivation of Concepts, Descriptions and Relationships.

Due to the origins of SNOMED CT, some SNOMED CT Concepts represent classification concepts that have imprecise and potentially changeable meanings. These are marked with the inactivation indicator value [900000000000486000|limited]. However, these concepts and were considered active until the January 2010 release of SNOMED CT. At that point, due to a change in editorial policy, this status was declared to be inactive.  

4.1.1.4.2 Component features - Identifiers

Components within SNOMED Clinical Terms are identified and referenced using numeric Identifiers. These Identifiers have the data type SCTID (SNOMED CT Identifier).

The SCTID data type is 64-bit integer which is allocated and represented in accordance with a set of rules. These rules enable each Identifier to refer unambiguously to a unique component. They also support separate partitions for allocation of Identifiers for particular types of component and namespaces that distinguish between different issuing organisations.

4.1.2 Derivatives

This section describes derivatives that are specified by and distributed as part of SNOMED CT. Derivatives are artefacts which are either required or useful to support some aspect of SNOMED CT enabled implementation. These artefacts are known as derivatives because they are derived from SNOMED CT Components and either add properties to them or specify sets of related components. All SNOMED CT enabled applications need to support some derivatives.

The set of derivatives that need to be supported by an implementation depend on user requirements for particular types of functionality. Important aspects of functionality that require support for relevant derivatives include:

- Tracking changes to the status of components;
- Filtering and prioritising searches;
- Representing alternative navigation hierarchies;
- Adding annotations to components;

Some Concepts derived from classifications such as ICD-10 include the abbreviations NOS (not otherwise specified) or NEC (not elsewhere classified). These are only valid in respect of a particular classification and change in their meaning if additional precisely defined codes are added to that part of the classification. Furthermore, a Concept that is not otherwise specified in ICD-10 may well be more precisely represented by another SNOMED CT Concept and thus from a SNOMED CT perspective "otherwise classified."
• Mapping to and from other coding schemes and classifications.

4.1.2.1 Reference Sets

Reference Sets are a flexible standard approach used by to support a variety of requirements for customization and enhancement of SNOMED CT content. These include representation of subsets, language preferences maps for or from other code systems.

Practical uses of Reference Sets include:

• Indicating the descriptions that contain acceptable and preferred terms for each concept in a particular language or dialect;
• Subsets of components that are included, excluded from the set of values that can be used in a particular country, organisation, specialty or data entry context;
• Frequency of use of descriptions or concepts in particular country, organisation, specialty or context;
• Suitability of particular concepts for use in a particular field in a record or message;
• Structure and ordering of hierarchies displaying concepts for user navigation.

Rows in Reference Set files reference a component that is a member of the set and may associate some additional information with the referenced component (e.g. whether a term is acceptable or preferred, codes that are the target of a maps).

Some types of Reference Set may also be represented by an intensional definition specified as a set of rule or constraints (e.g. all subtypes of a specified concepts).

4.1.2.2 Navigation Hierarchies

SNOMED CT subtype Relationships provide a logical semantic hierarchy. Often it is possible to view parts of the terminology and select particular Concepts by navigating through this subtype hierarchy. However, there are many situations in which the pure subtype hierarchy does not provide an ideal route for navigating to concepts.

Navigation links are used to provide an alternative route through parts of the terminology. A navigation link can link any two Concepts together to identify a useful route for navigation. Each of the navigation links is directional, linking a navigational parent Concept to a more refined navigational child Concept. However, unlike the subtype relationship the presence or absence of a navigation link neither adds to nor subtracts from the definition of either of the Concepts that it links.

Some Concepts may exist only to provide nodes in a navigation hierarchy. These Concepts are subtypes of navigational Concept and play no part in the semantic definitions of any other Concept.

4.1.2.2.1 Uses of Navigational Hierarchies

4.1.2.2.1.1 Breaking down a subtype into manageable categories

Some Concepts have a large number of subtype children that cannot be logically divided into intermediate subtypes. At the user interface these result in long lists of options, which are difficult to visualise and navigate. Navigational Concepts with appropriate navigational links to the supertype parent and its subtype children provide an intermediate layer without disrupting the semantic definitions.

The clinical finding top-level Concept has a large number of subtype children. Intermediate navigation Concepts group some of these together in a convenient way.

Example:

Three subtypes related to pregnancy are grouped together under a single natural navigational Concept:

• Disorder of pregnancy / labour / delivery / puerperium [navigation concept];
• Disorder of pregnancy;
• Disorder of labour / delivery;
• Disorder of puerperium.

4.1.2.2.1.2 Bypassing levels in the subtype hierarchy

Some Concepts that are members of the same rational set of choices may be found at different levels in the subtype hierarchy. This may occur because some have intervening subtypes and some of these intervening concepts may not be required for data entry. Addition of new concepts in a
release may change the concepts available at some levels in the subtype hierarchy. Navigation links can "bypass" levels in the subtype hierarchy to represent a rational sets of choices for use in a particular situation.

**Example:**
While it is semantically correct to nest | common cold | in the following subtype hierarchy, a user may reasonably expect to see "common cold" as an immediate navigational child of | upper respiratory infection |.

- | upper respiratory infection |
  - | Viral upper respiratory tract infection |
  - | common cold |

### 4.1.2.1.3 Linking related Concepts of different types

Navigational links can also be used to provide access to connected Concepts even when they are from different hierarchy branches.

**Example:**
A navigation links could associate:

- "hypertension" (the disorder) with | blood pressure | (the observation);
- | cataract | (disorder / finding) with "cataract surgery" (the procedure).

### 4.1.2.1.4 Ordering the display of subtypes

Sibling Concepts in a subtype hierarchy are not ordered. However, at the user interface a particular order may be useful to highlight commonly used Concepts or to mirror a conventional ordering.

**Example:**
Vertebrae, cranial nerves, disease stages, etc.

Navigational links are ordered and are used to impose order, even when the set of navigational children is the same as the set of subtype children.

### 4.1.2.1.5 Providing alternative hierarchies

The subtype hierarchy is logically defined and there can only be one such hierarchy. However, as navigation hierarchies have no definitional consequences, it is possible to have different hierarchies for different groups of users with differing needs.

Initial releases of SNOMED CT will contain a single set of navigation links but those engaged in technical implementation should be aware that in the future there may be separate sets of navigation links for use in different environments.

### 4.1.2.3 Maps

SNOMED CT specifications and content include resources that support Mapping to and from other code systems, classifications and terminologies. These resources support simple mapping, where there is a one-to-one Relationship between a SNOMED CT concept and code in a target scheme, and more complex maps where these are required.

More complex mapping requirements supported by the SNOMED CT Mapping model include:

- Maps from a single SNOMED CT concept to a combination of codes (rather than a single code) in the target scheme.
- Maps from a single SNOMED CT concept to choice of codes in the target scheme. In this case, the resolution of the choices may involve:
  - Manual selection supported by advisory notes.
  - Automated selection based on rules that test other relevant characteristics in the source data (e.g. age and sex of the subject, presence or absence of co-existing conditions, etc).
• A combination of automated processing with manual confirmation or selection where rules are insufficient to make the necessary decisions.

In Release Format 2 Maps are represented using Reference Sets. The type of Reference Set used varies according to the nature and complexity of the mapping, there is a Simple Map Reference Set and a Complex Map Reference Set.

4.1.2.4 Search support

The Developer Toolkit, which is supplied as part of the SNOMED CT International Release, includes several tables that can be used to simplify and provide support for text searching.

There are two WordKey Tables. These tables link each word used in SNOMED CT to every:
• Description in which it is used;
• Concept associated with an active description in which the word is used.

There are also two Dualkey Tables. These tables link each abbreviated word pair to every:
• Description in which that pair of words is used;
• Concept in which the combined set of active descriptions contains that pair of words.

These tables are provided to assist implementation. However, use of these tables is optional, as developers may generate and use alternative search support resources.

An extended version of the Developer Toolkit, provides Java® programs to generate indexes that may be useful to organisations that develop SNOMED CT Extensions.

4.1.3 Extensions

SNOMED CT is designed to allow the International Edition to be enhanced by adding Extensions that meet national or local requirements. Extensions are managed by IHTSDO Members or Affiliates who have been issued with a Namespace Identifier, which distinguishes the Identifiers of the Components they maintain. An Extension may contain Components of various types (e.g. Concepts, Descriptions, Relationships, and Derivatives including Reference Sets used for a variety of purposes).

4.1.3.1 Rationale for Extensions

SNOMED CT is a detailed clinical terminology which covers a broad scope. However, some groups of users will need additional Concepts, Descriptions or Reference Sets to support national, local or organisational needs.

This section explains the structures that enable IHTSDO Members (National Release Centers) and IHTSDO Affiliates to add Concepts, Descriptions, Relationships and Reference Sets to complement the SNOMED CT International Release.

The Extension mechanism allows SNOMED CT to be adapted to address the terminology needs of a country or organisation which are not met by the International Release. The mechanism provides a structure within which the components of each Extension are uniquely identified and attributed to a specific issuing organisation. This ensures that, when instance data containing content from different Extensions if communicated, the provenance of each referenced Concept is clear and ambiguity is avoided. Since the International Release and all Extensions share the same common structure, the same application software can be used to enter, store and process information from different extensions. Similarly, Reference Sets can be constructed that refer to content from the International Release and a variety of Extensions.

The common structure also means that, content developed by one organisation can where relevant be easily submitted for possible inclusion in a National Edition or in the International Edition.

Using the extension structure can also help organisations transfer responsibility for terminology to the IHTSDO or to another organisation, subject to the terms of the Affiliate Licence.

• Local content requirements that are likely to have wider applicability should be submitted to a National Release Center for consideration.
• National requirements likely to have International value should be submitted to the IHTSDO so they can be considered for inclusion in the International Edition.
4.1.3.2 Practical uses of Extensions

An Extension mechanism offers many advantages to developers, vendors, terminologists, national bodies and users.

Such a mechanism allows:

- **Users** to access the **SNOMED CT International Release** and one or more Extensions through a single user interface;
- **Developers** to implement **SNOMED CT Extensions** without developing specialised software;
- **Vendors** to develop and sell products to take advantage of both International Release content and Extensions;
- **Organisations** to develop and share terminology that meet their business needs, without procuring software;
- **IHTSDO Affiliates** to develop terminology that can be shared with other organisations and considered for addition to the International Release content;
- **IHTSDO Affiliates** to use locally-developed terminology without potential overlap with the work of other organisations.

This structure also enables specialised Concepts and Descriptions within an Extension to be related to Concepts and Descriptions distributed as part of SNOMED CT.

- **An Extension Concept** may be:
  - A national or organisational definition of a concept, which is more rigorous or specific than that generally applied to the **SNOMED CT Concept**;
  - An experimental procedure that is not established sufficiently to merit the inclusion in the main body of SNOMED CT but which may be in a local controlled study.

- **Extension Descriptions** may be colloquial synonyms for a **SNOMED CT Concept** or descriptions for an Extension Concept.

- **Extension Relationships** may be required to allow analysis packages or decision-support protocols to access additional information about a **SNOMED CT Concept** or to describe relationships between Extension Concepts:
  - Links between local procedures and relevant administrative actions;
  - Links between local procedures and **SNOMED CT Procedures**.

- **Extension Reference sets** may group **SNOMED CT Concepts** in ways that are specific to data entry contexts of a particular application or communication specification.

The Concepts, Descriptions, Relationship and Reference Sets that form an Extension must be:

- Distinguishable from the main body of SNOMED CT, not only in the thesaurus, but also when stored in a patient record, query or decision support protocol;
- Distinguishable from other Extensions, in the same way as they are distinguishable from the main body of SNOMED CT;
- Able to be distributed and processed in the same way as equivalent components from the main body of SNOMED CT without requiring specific adaptations of SNOMED-enabled applications.

The requirements for Extensions can be summarised as follows:

- Support for extra terminology components including Concepts, Descriptions, Relationships and Reference Sets:
  - These extra components behave as though they are components of SNOMED CT but they are distinguishable from components that are part of the SNOMED CT International Release.

- Globally unique identification of any terminology component that may be used outside the scope of a limited local environment:
  - The mechanism allows several organisations to issue mutually exclusive Identifiers for components of their Extensions.
  - To avoid the risk of misinterpretation, this mechanism is effective in various contexts including:
• Within the thesaurus;
• In patient records;
• In queries, decision-support protocols or knowledge bases.

• The mechanism indicates when Concepts have moved, or are expected to move, between an Extension and the International Release, or from one Extension to another.
• A shared understanding of the responsibility of an organisation that creates an Extension and provides it for the use of other organisations. These responsibilities include:
  • Maintenance of the Concept, Descriptions, Relationships, and Reference Sets;
  • Inactivation of these components as appropriate (duplication, ambiguous, outdated, etc.);
  • Submission to an IHTSDO Member's National Release Centre for consideration as an addition to a National Edition or to the International Release content.

4.1.4 Instance data

4.1.4.1 Introduction
This section describes the use of SNOMED CT to express clinical ideas in patient records, messages, documents, decision support protocols, queries and other artefacts.

Applications need to create, manipulate and consistently interpret standard SNOMED CT representations in instance data to support the entry, storage, retrieval and communication of clinical information.

4.1.4.2 Expressions
An expression is a structured combination of one or more concept identifiers used to express an instance of a clinical idea.

• **precoordinated expression**: An expression containing a single concept identifier is precoordinated. The clinical idea it expresses is represented by the identified concept. The defining relationships of that concept precoordinate its meaning.

• **postcoordinated expression**: expression that contains two or more concept identifiers is postcoordinated. The concept identifiers in a postcoordinated expression are related to one another in ways that build a more specific clinical idea. The required meaning is expressed by postcoordinating several clinical ideas each of which is represented by an identified concept.

  **Example**: A postcoordinated expression can indicate the specific site of a finding even when that specific combination of disorder and site is not represented by a single SNOMED CT Concept.

4.1.4.3 Terminology Bindings
Terminology binding is one part of the process of specifying constraints on the way that information is structured and represented.

Consistent representation is a prerequisite for effective retrieval and reuse of clinical record information. Requirements for reuse are many and varied, ranging from direct support for the care of the individual patient, through to aggregate analysis for research, statistics and audit. The common theme of these requirements is the need to retrieve particular items of information reliably and consistently, irrespective of the environment in which the data was entered and stored.

Since both the information model and SNOMED CT contribute to the processable meaning of an entry in a clinical record it is essential to manage the interdependencies between these two components.

Simple requirements can be addressed by specifying a value-set consisting of the permitted coded values that can be used in a particular field. However, effective representation of clinical records requires a rich information model and an expressive terminology.

Models such as EN13606 and the HL7 RIM provide the necessary structural flexibility and SNOMED CT postcoordinated expressions provide expressivity. An inevitable side-effect of a richer approach to information representation is an increase in the interdependencies and overlaps between the information model and the terminology. In order to specify and validate consistent representation of meaningful clinical
records, constraints must be applied to both the information model and terminology. These constraints must address all the facets of the model and terminology (e.g. including the use of postcoordination and the effect of modelled record structures). The constraints on information model and terminology components must be integrated, or bound together, in ways that ensure consistency, avoid ambiguity and minimise the number of different ways in which the same meaning may be expressed.

A terminology binding is an instance of a link between a terminology component and an information model artefact. Therefore, it is necessary to consider the representation of the required terminology components and the way these are associated with relevant information model artefacts.

The information model artefact to which a terminology binding is applied may be a field of a class in a static model or a collection of fields of one or more related classes.

Bound components include:

- Information model artefacts:
  - Coded attributes in an HL7 Version 3 model, an EN13606 Archetype or in the proprietary information model of an operational application.

- Terminology components:
  - Constraints on SNOMED CT expressions.

### 4.1.4.4 Expression Constraints

SNOMED CT contains hundreds of thousands of Concepts and this rich resource is greatly expanded by use of postcoordinated expressions. In any given situation the range of Concepts or expressions that are useful, relevant and meaningful is much more limited. This gives rise to a requirement to represent constraints on the content or a particular field in a way that can be interpreted and applied by application software.

The simplest constraint requirements can be met by specifying the list of valid codes. This requirement is addressed by subsets specified using the Reference Set mechanism. In some cases, it is useful to express the range of possible values ‘intensionally’ by specifying rules rather than by listing every member of the set (e.g. to include all concepts that are subtypes of a specified concept).

The use of postcoordinated expressions adds further dimensions to the requirement for constraints. It may be necessary to specify whether all postcoordinated refinements of concept are permitted or whether some types of refinement are prohibited or required. It may also be necessary to specify whether a postcoordinated expression that is equivalent to a permitted value is itself permitted.

Requirements for representing expression constraints are closely related to the requirements for representing query predicates in queries.

### 4.1.4.5 Query Predicates

Queries to be applied to electronic health records that including SNOMED CT expressions may need to represent predicates that test postcoordinated expressions. The requirements for representing postcoordinated expression query predicates are closely related to the requirements for representing constraints on expressions. While a constraint specifies whether a particular expression is permitted in a particular situation, an expression predicate specifies the range of candidate expressions that match the query.

### 4.2 Logical Abstract Models

This section provides a logical abstract view of SNOMED CT components and derivatives; and the use of these to represent instances of clinical information. Subsequent sections provide detailed technical descriptions of the SNOMED CT components, derivatives and related artefacts.
4.2.1 Logical Model of SNOMED CT Components

The abstract logical model of SNOMED CT components is illustrated by Figure 11. The model is centered around the representation of concepts and their associated relationships and descriptions.

Alignment between release files and the logical model:

- SNOMED CT Release Format 2 is closely aligned with the logical model;
- A mapping table is provided with the Release Format 1 file specification to map RF1 file structures to the abstract model.

4.2.1.1 Descriptions

The set of terms that describe a concept. These include fully specified names, preferred terms and synonyms in each supported language.

4.2.1.2 Relationships and concept definitions

Each concept is defined by a set of relationships to other concepts. The resulting definition may be sufficient to distinguish the concept from its parents and siblings in the subtype hierarchy in which case the concept is considered to be fully defined. If the definition is not sufficient to distinguish the concept from its parents and siblings, the concept is said to be primitive. The concept contains a field that is set to indicate whether is definition status is primitive or fully defined.

Figure 12 illustrates the abstract logical model of a concept, including the defining Relationships between concepts (represented by the associations labelled sourceId, destinationId and typeId) and the definition status (represented by the definitionStatusId).
4.2.1.3 Alternative logical abstract model views of concept definitions

The definition of a concept can be logically transformed between different views without loss of meaning based on the definitions of related concepts.

For example:

Consider the following set of defining relationships:

| pain in upper limb | is a | pain |
| pain in upper limb | has | finding site | upper limb structure |
| hand structure | is a | upper limb structure |
| Hand pain | is a | pain |
| Hand pain | has | finding site | hand structure |

Based on the above five relationships it is possible to infer a new relationship:

| Hand pain | is a | pain in upper limb |

The definition of Hand pain can thus be viewed in three semantically identical forms:

1. As originally stated:
   - | Hand pain | is a | pain | and has | finding site | hand structure |
   
or
2. With the additional inferred relationship:
   - | Hand pain | is a | pain | and | is a | pain in upper limb | and has | finding site | hand structure |
   
or
3. With the inferred relationship but without the redundant stated relationship | is a | pain |
   - | Hand pain | is a | pain in upper limb | and has | finding site | hand structure |

The relationship is a | pain | is redundant because this can be determined by traversing the relationship to | pain in upper limb | which in turn is defined as | is a | pain |.
The result of manipulations like this is that several distinct views of the logical abstract model can be described based on the manner in which they are derived.

Different views of concept definitions vary in one or more of the following three dimensions:

- Flattened or nested;
- Stated or inferred;
- Direction and extent of logical transformation

These three dimensions are considered in the following subsections of this guide.

4.2.1.3.1 Flat and nested definition views
4.2.1.3.1.1 Flat definition views

In a flat view a concept definition consists only of defining relationships with target values that are themselves identified concepts.

To support this view concepts must be created (and defined) for any value that needs to be expressed in the definition of another concept.

Example: The finding site for the concept pain in left hand could only be defined by first creating a concept structure of left hand, leading to a definition such as:

| pain in left hand | has | is a | pain |
| pain in left hand | has | finding site | structure of left hand |

The concept structure of left hand could be defined as follows:

| structure of left hand | is a | hand structure |
| structure of left hand | has | laterality | left |

4.2.1.3.1.2 Nested definition views

In a nested view of a concept definition the target value of a defining relationship may itself be a nested definition.

This avoids the need for creating intermediate concepts but results in more complex definitions.

Example: The finding site for the concept pain in left hand could be defined without creating the concept structure of left hand by nesting an appropriate definition as follows:

| pain in left hand | is a | pain |
| pain in left hand | has | finding site | (is a | hand structure | and has | laterality | left )|

4.2.1.3.1.3 SNOMED CT support for flat and nested definition views

Currently the SNOMED CT editing environment works with flat definition views and the standard relational distribution files do not support nested definition views.

Views of concept definitions that include nested definitions can be generated from existing SNOMED CT data. The proposed SNOMED CT XML distribution format does have the potential to support nested views.

Logically the flat form is as expressive as the nested form. The only difference is the need to create and define concepts to represent the nested elements in the definition.

Example:

To allow the concept pain in left hand to be fully defined without using a nested definition, structure of left hand must exist as a concept in SNOMED CT.

4.2.1.3.2 Stated and inferred definition views
4.2.1.3.2.1 Stated definition view

A stated concept definition is the set of relationships (and groups of relationships) that an author (modeler) has stated to be defining characteristics of a concept. The stated
view is maintained in the SNOMED CT editing environment and is reviewed and modified during the process of editing a revised edition of SNOMED CT.

The stated view is distributed in a format similar to the relationship file.

4.2.1.3.2.2 Inferred definition views

Inferred concept definitions are derived from a stated concept definition taking account of the definitions of the concepts referred to in the stated definition.

Inferences are derived by applying a consistent set of logical rules to the definition taking account of the definitions of related concepts.

Several semantically identical views may be inferred and these are discussed in the following section.

The standard SNOMED CT distribution includes the relationship file which represents one of the inferred views of the definitions of all active concepts.

4.2.1.3.2.3 Alternative inferred definition views

Several semantically identical views may be inferred by applying different logical transformations to the stated view. Logical transformations may vary in the extent to which they normalise the definition and the level of redundancy in the resulting definition.

Different inferred views have properties that optimise different types of function.

The extreme points in the spectrum of possible concept definition views are:

- Comprehensive:
  - The set of all defining relationships that can be inferred to be true for a concept based on the stated definition of this concept and the stated definitions of all other directly or indirectly related concepts.

- Minimal:
  - The smallest set of defining relationships that expresses the definition of the concept.

Each inferred view is a combination of a specific supertype view (| is a | relationships) and an attribute view (other defining relationships).

4.2.1.3.2.3.1 Supertype aspects of inferred definition views

An inferred definition view includes one of several alternative views of the supertype | is a | Relationships. The considerations in this section exclude the defining characteristics of a concept.

4.2.1.3.2.3.1.1 Comprehensive view of supertype ancestors ("transitive closure")

An inferred concept definition view may explicitly contain relationships to all supertypes ancestors of the defined concept.

This comprehensive view of supertypes is known in description logic as a "transitive closure". It involves traversing (transiting) the target of each | is a | relationship to look for and follow further | is a | relationships until all paths through the hierarchy reach the root concept (closure).

This is a highly redundant expression of the logical abstract model of a concept definition. Applied to the full content of SNOMED CT it results in tens of millions of relationships.
Table 6: Transitive Closure of Supertypes in the Example Hierarchy

<table>
<thead>
<tr>
<th>Concept</th>
<th>Transitive closure of supertypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>A, B, C</td>
</tr>
<tr>
<td>E</td>
<td>A, C</td>
</tr>
<tr>
<td>F</td>
<td>A, C</td>
</tr>
<tr>
<td>G</td>
<td>A, B, C, D</td>
</tr>
<tr>
<td>H</td>
<td>A, B, C, D, E</td>
</tr>
<tr>
<td>J</td>
<td>A, C, E, F</td>
</tr>
<tr>
<td>K</td>
<td>A, C, F</td>
</tr>
<tr>
<td>L</td>
<td>A, B, C, D, E, G, H</td>
</tr>
<tr>
<td>M</td>
<td>A, B, C, D, E, F, H, J</td>
</tr>
</tbody>
</table>

The advantage of this type of view is that there is no need to walk the hierarchy tree to answer the question "is concept M subsumed by concept B". Instead this can be answered simply by checking the transitive...
closure of "concept M" for the presence of "concept B". Therefore, this view enables high-performance subsumption testing.

Note: Experience suggests that a pre-computed transitive closure table out-performs other options and is robust, flexible and easy to implement. Therefore, unless storage capacity is significant concern, this approach is recommended.

4.2.1.3.2.3.1.2 Proximal supertype view (standard distribution view)

An inferred view of a concept definition may contain relationships to the set of proximate supertype parents of that concept. Relationships with other supertype ancestors that can be reached by traversing multiple is a | relationships are omitted.

Figure 14: Example hierarchy with list of proximal supertypes

Table 7: Proximal Supertypes in the Example Hierarchy

<table>
<thead>
<tr>
<th>Concept</th>
<th>List of proximal supertypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>B, C</td>
</tr>
<tr>
<td>E</td>
<td>C</td>
</tr>
<tr>
<td>F</td>
<td>C</td>
</tr>
<tr>
<td>G</td>
<td>D</td>
</tr>
<tr>
<td>H</td>
<td>D, E</td>
</tr>
</tbody>
</table>
4.2.1.3.2.3.1.3 Comprehensive primitive supertype view

An inferred view of a concept definition may contain relationships to all supertype ancestors that are "primitive" concepts (yellow shaded in examples).

The rationale for this is that all the distinguishing features of the "fully defined" concepts (white unshaded in examples) are represented by other defining relationships which will show up in the attribute part of the view.

This view can be used when testing whether a candidate concept is subsumed by a predicate expression. If the proximal primitive supertype view of the predicate expression includes any concept that is not in the comprehensive primitive view of the candidate concept definition, then the concept is not subsumed by the expression.

![Diagram of concept hierarchy]

Figure 15: Example hierarchy with comprehensive list of primitive supertypes

Table 8: Primitive Supertypes in the Example Hierarchy

<table>
<thead>
<tr>
<th>Concept</th>
<th>Comprehensive list of primitive supertypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>A, B</td>
</tr>
</tbody>
</table>
Comprehensive list of primitive supertypes

<table>
<thead>
<tr>
<th>Concept</th>
<th>Comprehensive list of primitive supertypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>A, B</td>
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<tr>
<td>E</td>
<td>A, E</td>
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<td>L</td>
<td>A, B, E, G</td>
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<tr>
<td>M</td>
<td>A, B, E, F</td>
</tr>
</tbody>
</table>

Note:

1. In this view the definitions of primitive concepts should implicitly or explicitly include a reference to the defined concept itself. This is because a primitive concept expresses some meaning that is not fully distinguished from its supertypes by other defining relationships. The reference to self need not be explicitly stored and provided that it is included implicitly at run time.

2. All active concepts include the root concept in their transitive closure. The reference to root need not be explicitly stored provided that it is included implicitly at run time.

4.2.1.3.2.3.1.4 Proximal primitive supertypes (short normal view)

An inferred concept definition may contain relationships to the set of proximate primitive supertype parents of that concept. Relationships with fully defined supertype ancestors are omitted as are relationships with primitive ancestors that are also supertypes of one of proximate primitive supertypes.

This view can be used to test if a candidate expression is subsumed by a predicate concept. If the proximal primitive supertype view of the concept definition of the predicate includes any concept that is not in the comprehensive primitive view of the candidate expression, then the expression is not subsumed by the concept.

The relationships in the SNOMED CT’canonical table’ represent this view.
Figure 16: Example hierarchy with list of proximal primitive supertypes

Table 9: Proximal Primitive Supertypes in the Example Hierarchy

<table>
<thead>
<tr>
<th>Concept</th>
<th>List of proximal primitives</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>H</td>
<td>B, E</td>
</tr>
<tr>
<td>J</td>
<td>E, F</td>
</tr>
<tr>
<td>K</td>
<td>F</td>
</tr>
<tr>
<td>L</td>
<td>E, G</td>
</tr>
<tr>
<td>M</td>
<td>B, E, F</td>
</tr>
</tbody>
</table>

**Note:** The proximal *primitive* of a *primitive concept* is the *concept* itself.
4.2.1.3.2.3.2 Attribute aspects of concept definition views

An inferred definition view includes one of several alternative views of the *defining characteristics* of a *concept*. The considerations in this section exclude the supertype | is a | relationships.

In addition to the different views described in this section, alternative logical forms may be applied to the values of the relationships.

4.2.1.3.2.3.2.1 Comprehensive view of defining Relationships

An inferred *concept definition* may include all the defining *relationships* (and relationship groups) that are known to be true. This includes those stated and other inferred by inheritance from stated supertype ancestors.

The full form includes all possible supertype ancestor values of the stated attributes. This means that in many cases this will include a very large set of relationships.

Taken to its logical extreme this also includes relationships duplication of relationships with relationship types that are supertypes of those types stated (e.g. all | procedure site - indirect | relationships would be duplicated for the supertype attribute | procedure site |).

While this version of the definition model is an Abstract Logical view it is unlikely that explicit representation of this view will deliver benefits sufficient to merit this level of redundancy.

![Diagram of sample concepts with differentiating defining characteristics]

**Figure 17:** Illustration of sample concepts with differentiating defining characteristics

**Table 10: Comprehensive attribute view of sample concepts**

See Figure 17

<table>
<thead>
<tr>
<th>C.</th>
<th>Injury disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>morphology</td>
<td>site=</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D.</th>
<th>Injury of upper limb</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>site= upper limb structure</td>
</tr>
<tr>
<td>morphology</td>
<td>morphology=</td>
</tr>
</tbody>
</table>
### Table 11: Non-redundant attribute views of sample concepts

<table>
<thead>
<tr>
<th>C.</th>
<th>Injury disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>morphology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D.</th>
<th>Injury of upper limb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>site</td>
</tr>
<tr>
<td></td>
<td>morphology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E.</th>
<th>Bone or arm injury (primitive)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>morphology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F.</th>
<th>Bone or joint injury (primitive)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>morphology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>G.</th>
<th>Severe upper limb laceration (primitive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>= upper limb structure</td>
</tr>
<tr>
<td>morphology</td>
<td>= injury</td>
</tr>
<tr>
<td>severity</td>
<td>= severe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H.</th>
<th>Hand injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>= upper limb structure</td>
</tr>
<tr>
<td>morphology</td>
<td>= injury</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>J.</th>
<th>Fracture (disorder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>= bone structure</td>
</tr>
<tr>
<td>morphology</td>
<td>= injury</td>
</tr>
<tr>
<td>morphology</td>
<td>= fracture</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K.</th>
<th>Joint injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>= joint structure</td>
</tr>
<tr>
<td>morphology</td>
<td>= injury</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L.</th>
<th>Severe laceration of hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>= upper limb structure</td>
</tr>
<tr>
<td>site</td>
<td>= hand structure</td>
</tr>
<tr>
<td>morphology</td>
<td>= injury</td>
</tr>
<tr>
<td>severity</td>
<td>= severe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M.</th>
<th>Scaphoid fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>site</td>
<td>= upper limb structure</td>
</tr>
<tr>
<td>site</td>
<td>= hand structure</td>
</tr>
<tr>
<td>site</td>
<td>= bone structure</td>
</tr>
<tr>
<td>site</td>
<td>= scaphoid bone structure</td>
</tr>
<tr>
<td>morphology</td>
<td>= injury</td>
</tr>
<tr>
<td>morphology</td>
<td>= fracture</td>
</tr>
</tbody>
</table>

**Note**

Although the morphology | laceration | is not specified in the example | severe upper limb laceration | refined to the site hand fully defines this concept.

In a complete view (including supertypes and attributes) this difference is clear.

### 4.2.1.3.2.3.2.2 Non-redundant defining Relationships ("distribution view")

An inferred concept definition may include the set of non-redundant defining relationships (and relationship groups) that are known to be true. This includes those stated and others inferred by inheritance from stated supertype ancestors. However, any relationships (or relationship groups) that are supertypes of other relationships (or relationship groups) are redundant and are not included in this view.

A relationship that is part of a relationship group is only regarded as redundant if the relationship group as a whole subsumes another relationship group.

This is the view expressed in the standard SNOMED CT distribution and this same view also forms part of the long normal form.
4.2.1.3.2.3.2.3 Primitive differential attribute view of concept definitions

The *primitive* differential view includes only non-redundant defining *relationships* (and *relationship groups*) that are not present in the sum of the definitions of the set of *primitive* supertype concepts. This view provides a minimal attribute view which is semantically complete when combined with one of the *primitive* supertype views.

A *relationship* that is part of a *relationship group* is only regarded as redundant if the *relationship group* as a whole subsumes another *relationship group*.

Table 12: Primitive differential attribute views of sample concepts

See *Figure 17*
K. Joint injury
- site => joint structure
- morphology => injury

J. Fracture (disorder)
- site => bone structure
- morphology => fracture

L. Severe laceration of hand
- site => hand structure

M. Scaphoid fracture
- site => scaphoid bone structure
- morphology => fracture

4.2.1.3.2.3.2.4 Supertype differential attribute view of concept definitions

The supertype differential view includes only non-redundant defining relationships (and relationship groups) that are not present in the sum of the definitions of the supertypes of the concept. This view provides a minimal attribute view which is semantically complete when combined with the proximal or complete supertype view.

Note:

1. This is the attribute view expressed in the SNOMED CT canonical form table.
2. If the primitive supertype view of primitive concepts includes the concept itself (i.e. as its own proximal primitive) then the differential attribute view is empty for all primitive concepts. The entries shown above for primitive concept apply only where the concept itself is excluded from the proximal primitive supertype view.

Table 13: Supertype differential attribute views of sample concepts

See Figure 17

C. Injury disorder
- morphology => injury

D. Injury of upper limb
- site => upper limb structure
- morphology => injury

E. Bone or arm injury (primitive)

F. Bone or joint injury (primitive)

G. Severe upper limb laceration (primitive)
- severity => severe

H. Hand injury
- site => hand structure

J. Fracture (disorder)
- site => bone structure
- morphology => fracture

K. Joint injury
- site => joint structure

L. Severe laceration of hand
None

Note
All distinguishing characteristics are inherited from one or both of the supertypes.
4.2.1.3.2.3 The Short Canonical Form

The short canonical form is an alternative view of the Relationships that is provided as an RF1 release file. It consists of the union of the following two views:

- **Proximal primitive supertypes (short normal view)**
- **Primitive differential attribute view of concept definitions.**

4.2.1.3.3 Nature of the definition

A **concept definition** has one of the following two forms:

1. **fully defined concepts** :
   - The definition is complete. It contains relationships that represent the full set of necessary and sufficient conditions.

2. **primitive concepts** :
   - The definition is incomplete. It contains relationships that represent a set of necessary conditions but this set of conditions is not sufficient to fully define the concept.

**Note:** A necessary condition is a characteristic that is always true of a concept.

**Example:** | morphology | = | fracture | is a necessary condition of | fracture of femur |.

**Note:** If all members of a sufficient set of conditions are true they imply that the concept is also true.

**Example:** | morphology | = | fracture | and | finding site | = | bone structure of femur | form a sufficient set of conditions that define the concept | fracture of femur |.

**Note:** All members of the set of sufficient conditions are also necessary conditions. However, some necessary conditions may not form part of the sufficient set of conditions.

**Example:** Consider the concept | gastric ulcer |
- The | finding site | = | gastric mucosa | is a necessary condition for | gastric ulcer |
  - This is true because all gastric ulcers necessarily involve the | gastric mucosa |
- The definition | morphology | = | ulcer | and | finding site | = | stomach structure | is a sufficient definition for | gastric ulcer |
  - This is true because any ulcer in a stomach structure is a | gastric ulcer |
  - Therefore, an assertion that a person has an | ulcer | with | finding site | | stomach | is sufficient to imply that they have a | gastric ulcer |
  - Since a gastric ulcer necessarily involves the | gastric mucosa | it should be possible to deduce that a person with an "ulcer" with finding site | stomach | has a disorder of with a site | gastric mucosa |

4.2.1.3.3.1 Sufficient definition

A **sufficient definition** consists of a set of defining relationships (and relationship groups) which taken together imply a particular meaning.

The value of a sufficient definition is that it allows post coordinated expression that is sufficient to define a concept to be recognised as equivalent to (or a subtype of) a defined concept.

For example:

Gastric ulcer is defined as follows and this is a sufficient definition because any | ulcer | in a | stomach structure | is by definition a | gastric ulcer |.

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Based on this definition:

Any postcoordinated expression that specified a disease involving an ulcer with finding site stomach would be equivalent to or a subtype of gastric ulcer.

However, a query for all disorders involving gastric mucosa would incorrectly exclude the concept gastric ulcer as the site is not specified as some stomach structure rather than specifically identifying the gastric mucosa.

4.2.1.3.3.2 Necessary definition

A necessary definition consists of a set of defining relationships (and relationship groups) which express all the attributes that are necessarily true about a concept for a given version of the SNOMED CT Concept Model.

A necessary definition may contain relationships or refinements that are not essential for a sufficient definition.

The value of a necessary definition is that it allows more refined subsumption queries to be appropriately evaluated.

For example:

Gastric ulcer could be defined as follows:

116680003 | is a | 64572001 | disease | 116676008 | associated morphology | 56208002 | ulcer | 363698007 | finding site | 69695003 | stomach structure |

This more tightly defined definition contains a necessary definition (finding site gastric mucous membrane structure). This is necessarily true if the sufficient definition (finding site stomach structure) is true, because any ulcer in a stomach structure is by definition a gastric ulcer.

4.2.1.3.3.3 Limitations of the current SNOMED CT model

The current SNOMED CT model and distribution format do not distinguish between relationships that are necessary conditions and those that are part of a set of necessary and sufficient conditions. For any fully defined concepts the set of defining relationships are regarded as necessary and sufficient.

As a result of this limitation some currently released fully defined concept definitions may include conditions that are necessarily true but are not required as part of the set of sufficient conditions.

Example: Consider the two definitions shown below:

116680003 | is a | 64572001 | disease | 246075003 | Causative agent | 113858008 | mycobacterium tuberculosis complex | 116676008 | associated morphology | 6266001 | granulomatous inflammation | 363698007 | finding site | 78653002 | gastric mucous membrane structure |

116680003 | is a | 64572001 | disease | 246075003 | causative agent | 41146007 | bacteria | 116676008 | associated morphology | 23583003 | inflammation | 363698007 | finding site | 39352004 | joint structure |

Figure 18: | tuberculous arthritis |

Figure 19: | bacterial arthritis |

The definition of tuberculous arthritis differs from that of bacterial arthritis in two respects. In practise the first of these (causative agent mycobacterium tuberculosis complex) is sufficient to define the concept. However, the nature of the inflammation that results is, necessarily, granulomatous.

Thus an expression that specifies bacterial arthritis with causative agent mycobacterium tuberculosis complex is clinically equivalent to the concept tuberculous arthritis even though it does not explicitly refine the nature of the inflammation.

In contrast the current SNOMED CT model computes bacterial arthritis with causative agent mycobacterium tuberculosis complex as supertype of tuberculous arthritis. This occurs because
the expression | bacterial arthritis | with | causative agent =| mycobacterium tuberculosis complex | does not specify of the nature of the inflammation.

**Future enhancements:** Options for distinguishing the sufficient set of defining relationships from those that are merely necessarily true are being investigated. A complete solution to this issue needs to support the recognition of several separate sufficient sets. However, initially a solution recognising a single sufficient set may be introduced.

**4.2.1.3.3.4 Impact on retrieval**

A necessary definition is inevitably more complete than a sufficient definition. From the perspective of retrieval the completeness of a definition is a mixed blessing.

- It is an advantage for candidate expressions as they will be subsumed by a wider set of appropriate predicates.
- It is a disadvantage for a predicate expression, the necessary conditions may result in incomplete retrieval. A candidate expression that satisfies all the sufficient conditions should be included. However, it will be excluded unless it satisfies all the necessary conditions in the predicate.

This occurs where the definition of a concept states conditions that are necessarily true but which go beyond those that are sufficient to distinguish a concept from its supertypes.

**Example:**

The normal form definition of | pulmonary tuberculosis | is as follows:

116680003 | is a | 64572001 | disease |
,246075003 | causative agent | = 113858008 | mycobacterium tuberculosis complex |
{116676008 | associated morphology | = 6266001 | granulomatous inflammation |
,363698007 | finding site | = 39607008 | lung structure | }

Used as a query predicate, this will exclude valid candidate expressions such as ... 233604007 | pneumonia | :246075003 | causative agent | = 113861009 | mycobacterium tuberculosis |

- This expression is not subsumed by the full definition of | pulmonary tuberculosis | because it does not mention "granulomatous inflammation". This type of inflammation is characteristic of "mycobacterium tuberculosis" infection and so is necessarily present. Since currently SNOMED CT definitions do not distinguish the sufficient and necessary conditions this cannot be inferred.

A more inclusive query predicate that specifies a sufficient set of conditions for | pulmonary tuberculosis | can be constructed by removing the morphology condition.

116680003 | is a | 64572001 | disease |
,246075003 | causative agent | = 113858008 | mycobacterium tuberculosis complex |
,363698007 | finding site | = 39607008 | lung structure |

- This correctly subsumes both the precoordinated concept | pulmonary tuberculosis | and the postcoordinated candidate expression above.

**Note:** To ensure complete retrieval

- When selecting a concept as part of a query predicate, view its normal form definition and decide whether some of the conditions should be omitted;
- Specify the minimum set of conditions sufficient for the intended purpose.

**Future enhancements:** In future, when the SNOMED CT model is revised to distinguish sufficient sets of defining Relationships, the sufficient definition can be used as the predicate for a retrieval. A candidate expression matches a predicate if it necessarily fulfils all the sufficient conditions specified in the query.
4.2.2 Logical Model of SNOMED CT expressions

Figure 20 shows the general abstract model for a SNOMED CT expression. This diagram also shows the references between expressions and components.

An expression is a collection of references to one or more concepts. The expression consists one or more focus concepts and an optional refinement.

The focus concept and the names of the refining attributes are represented by references to SNOMED CT concepts. The value of a refining attribute is itself an expression and is structured in the same way. Thus nested expression can be used to refine the value of a refining attribute.

An expression represents an instance of the meaning defined by the defining relationships of the focus concepts as modified by the refinements.

The meaning of each refinement is expressed by an attribute name which names a property and an attribute-value which expresses the value of that property.

- The attribute name must be a concept that is a subtype of [attribute].
- The refinement value may be a concept or expression that is a appropriate to the named attribute. The values that are appropriate to an attribute are specified by the Concept Model. In most cases, any subtype of a concept that is permitted as a value of an attribute is also permitted.
- Refinements may be grouped to represent interdependencies between them in the same way as relationship groups.

Figure 20: General Abstract Logical Model of a SNOMED CT expression
4.2.2.1 Refinement

An expression represents an instance of the meaning of the focus concept as modified by refinements applied to that concept. Various types of refinement are possible. Of these some are fully supported by the SNOMED CT Concept Model and released data while other possible methods of refinement step outside those boundaries.

4.2.2.1.1 Refinement of defining Relationships

4.2.2.1.1.1 Refinement individual attribute values

A defining relationship of the base concept can be refined by applying a value that is a subtype of the defining value.

This approach to refinement is fully supported by the SNOMED CT Concept Model.

4.2.2.1.1.2 Refinement attribute names

A defining relationship of the base concept can also be refined by applying a name that is a subtype of the defining attribute name. For example, if the defining relationship specifies a | procedure site | this may be refined to | procedure site - direct | or | procedure site - indirect |.

4.2.2.1.1.3 Refinement of defining Relationship groups

If a refinement is applied to one of the defining relationships within a relationship group, it is the group as a whole that is refined.

It is also permissible for a stated (close-to-user) expression to refine a relationship without grouping the refined relationship or without fully enumerating the group of which it is part. In this case, resolution to an inferred structure should apply the ungrouped relationship value (or partially enumerated group) as a refinement of any group to which that refinement can be appropriately applied.

4.2.2.1.1.4 Nested refinement of defining Relationships

The value of a defining relationship may itself be refined. In this case the value of the relationship becomes a postcoordinated expression rather than a precoordinated concept.

This occurs most frequently in the following situations:

Laterality refinement

The laterality qualification applies to the value of the | procedure site | or | finding site | relationship and is logically nested under site.

(Note lateralisation is discussed separately)

Refinement of situation with explicit contexts

The | associated finding | or | associated procedure | is a | clinical finding | or | procedure |, which may itself be refined (e.g. with severity).

4.2.2.1.2 Applying values to qualifiers

4.2.2.1.2.1 Applying values to individual qualifiers

A qualifying relationship of the base concept can be used to apply a refinement.

The nature of the allowable refinement using qualifiers is determined by the refinability of the qualifying relationship.

Not refinable

The qualifier can only be used to refine the base concept by applying the qualifying value specified in the distributed table.

Refinable

The qualifier can be used to refine the base concept by applying the qualifying value specified in the distributed table or any subtype of that value.

Mandatory to refine

The qualifier can be used to refine the base concept by applying a subtype of the qualifying value specified in the distributed table. It cannot be applied with the specified value itself as this is a non-specific grouping value for possible refinements.
This approach to refinement is fully supported by the SNOMED CT Concept Model.

4.2.2.1.2.2 Grouping qualifier refinements

In theory the value of a qualifier may apply only to the content of one relationship group.

Currently qualifiers are not grouped in SNOMED CT releases and therefore grouping of qualifier refinements is not supported in the current Concept Model. However, this is under review and the model may be extended to include grouped qualifiers in future. This review is required because problems arise with subsumption testing where precoordinated definitions include grouped attribute-value pairs and the expression uses an ungrouped, qualified, attribute.

4.2.2.1.2.3 Nested refinement of qualifiers

The value of a qualifier may itself be refined and represented as an expression rather than a precoordinated concept.

This occurs most frequently with expressions which qualify high level "situation with explicit context" concepts (e.g. "finding with explicit context"). In this case the associated finding is applied as a qualifier which may itself be refined (e.g. with severity).

4.2.2.1.3 Applying laterality to a concept

A laterality value (left, right or bilateral) can be applied as a qualifier to lateralisable body structure concepts.

It is also permissible for a stated (close-to-user) expression to lateralise a base concept that has a definition including reference to a lateralisable body structure. In this case, resolution to an inferred structure should apply the laterality to all values in the base concept definition that are lateralisable body structures.

This approach is fully supported by the SNOMED CT Concept Model, provided that appropriate transforms are applied.

Note

If laterisation is specific to particular aspects of the concept then the laterality should be applied to the appropriate relationship as part of a nested expression.

4.2.2.1.4 Sanctioned and unsanctioned refinement

4.2.2.1.4.1 Introduction to refinement sanctioning

SNOMED CT relationships provide information that may be used to determine the types of refinements can be processed to determine equivalence and subsumption. However, even where a concept has no specific relationship it is possible to apply a refinement using an attribute that the Concept Model permits for concepts in that domain. Other attributes are not recommended for refinement as they will result in expression that cannot be normalised or reliably compared. Specific issues with unsanctioned refinements are considered in:

- Unsanctioned use of "Concept Model attributes";
- Use of "unapproved attributes";
- Advantages and disadvantages of unsanctioned refinements.

4.2.2.1.4.2 Unsanctioned use of "Concept Model attributes"

In some situations it may seem to be useful to use one of the attributes used in the SNOMED CT Concept Model to refine a concept that does not have a defining relationship or qualifier named by this attribute.

Provided that this is limited to qualifications that the Concept Model specifies for concepts of the same general type this approach can be applied. However, Concept Model attributes should not be applied to concepts of other types (for example the "approach" attribute should not be applied to a "finding"). Use of unsanctioned (but 'allowable') attributes for refinement may limit semantic interoperability.

Despite this limitation it may be appropriate to use a community agreed approach for a particular defined purposes. However, care should be taken to use attributes only in the manner described in the Concept Model Guide (6).
4.2.2.1.4.3 Use of "unapproved attributes"

The SNOMED CT release also includes a large number of attributes that are classified as "unapproved attributes".

Most of these originate from earlier terminology efforts. They have as yet not been applied in the SNOMED CT Concept Model and there is no guarantee that they will be used in a particular manner in the future.

This approach is not supported by the SNOMED CT Concept Model. Therefore any use of unapproved attributes for refinement is likely to limit semantic interoperability.

Despite these limitations, it may be appropriate to use a community agreed Reference Set of unapproved attributes within a defined user community for a particular defined purpose. Any such use should be fully documented by those responsible for its adoption. In the future as the SNOMED CT Concept Model evolves, additional supported attributes may provide a migration path for information recorded using a well-documented set of rules for a limited set of use cases.

4.2.2.1.4.4 Advantages and disadvantages of unsanctioned refinements

**Note:** THIS SECTION CONTAINS DISCUSSION NOTES ONLY.

The presence of defining or qualifying relationships certainly simplifies the task of implementing facilities for refinement. It also provides an indication that subsumption and equivalence computation may be possible. However, at this stage there is no definitive view of the extent to which SNOMED CT should sanction and permit particular refinements while deprecating or prohibiting other refinements.

**Disadvantages of prohibition of all unsanctioned refinements**

- **Lack of ability to express some required meanings:**
  - Until an attribute is included in the Concept Model and appropriately populated for all relevant concepts, it cannot be used to refine some concepts that might reasonably be so refined. The consequence of this are an inability to express some meanings required by users with approved SNOMED CT expressions.
  
  One example of this is that at present the following expression would not be sanctioned as headache has no associated severity qualifier. While this looks like an error that could readily be corrected it serves to illustrate the point.

  25064002 | headache |:246112005 | severity |=24484000 | severe |

**Disadvantage of allowing unconstrained refinement**

- **Nonsense expressions with no "sensible" meaning:**
  - e.g. 25064002 | headache |:103366001 | with color |=414497003 | infra-red |
  
  These are probably not a major cause for concern because it is impossible to create a foolproof approach that guarantees that all expressions will be sensible:
  
  - The following nonsense example is "sanctioned" in the sense that the site specified is a refinement of | head structure | which is the defined finding site for | headache |:
  
    25064002 | headache |: 363698007 | finding site |= 87056002 | infantile diploetic mastoid cell |
  
  - A nonsense expression is meaningless and where it is subsumed is largely irrelevant. Ideally it would subsume under nonsense expressions but that would require a knowledge of the rationality of all possible expressions.
  
  In the absence of a tractable way to prohibit nonsense, avoidance and management of nonsense is an issue for implementers, users and quality reviewers.
  
- **Nonsense expressions which may express a superficial "sensible" meaning:**
  - e.g. 25064002 | headache |:103366001 | with color |=301888000 | pale color |
  
  A person reading this might think this expresses the fact the person's head (or face) was pale at the time of the headache. Logically in SNOMED CT it would mean that the headache is pale in...
colour which is nonsense. However, an argument could be advanced that the same rules apply as those for indirect laterality and thus this could transform to:

- 25064002 | aching pain | 363698007 | finding site | 69536005 | head structure | 103366001 | with color | 301888000 | pale color |

- This is still nonsense from a SNOMED CT perspective or perhaps it could correctly mean is aching pain in the pale colored head structure. However, if the author (or authoring application) assigned such an expression to represent two distinct findings | headache | and "head is pale in colour" this meaning would not be apparent from a logical computational perspective.

- While prohibition of nonsense is not tractable it may be feasible to state rules that express which forms of expression are logical and computable. Furthermore the outcome of these rules needs to be deterministic so that the result of transforming do not differ according to implementation.

- **Alternative rational expressions of similar meanings**:

  - Consider the following:
    1. 25064002 | headache | 279114001 | character of pain | 410704005 | throbbing sensation quality |
    2. 162308004 | throbbing headache |
    3. code=162306000 | headache character | value | 410704005 | throbbing sensation quality |
      - This assumes an information model with an observable entity concept naming a value in a separate information model attribute (HL7 Observation supports this).
    4. 29695002 | throbbing pain | 363698007 | finding site | 69536005 | head structure |
    5. 25064002 | headache | 162306000 | headache character | 410704005 | throbbing sensation quality |

  - All these expressions appear rational but only options 2 and 4 have the same normal form in the present SNOMED CT Concept Model.

  - Potentially option 3 could also be computed if both (a) the information model terminology model interface was clear and (b) the SNOMED CT definition of 162308004 | throbbing headache | is enhanced to add "363713009|has interpretation|=410704005|throbbing sensation quality].

  - On the other hand option 1 is more in line with the way disorders are refined by "severity" and other qualitative refinements. For this to be computable equivalent the concepts "29695002|throbbing pain" and 162308004 | throbbing headache | would both need revised definitions in which they were defined as having "279114001|character of pain|=410704005|throbbing sensation quality]."

  - Option 5 also looks superficially reasonable and shares the general feel of option 3. However, since 162306000 | headache character | is an "observable entity" rather than an "attribute" this representation would be contrary to one fundamental principle of refinement - that the name of the refinement should be a subtype of the concept|attribute". This means current normal transform rules would not result in a proper normal form and indeed might reasonable report an error.

- **User interface design issues**:

  - Given all of the above points, application designers will struggle to create sensible and consistent interfaces unless advice on sanctioning is provided.

  - Different issues will apply according to the nature of the interface. For example this may include:
    - What options to offer users to allow refinement of specific concepts;
    - How to represent the meaning that results from selecting options on a structured data entry form as a SNOMED CT expression;
    - How to encode meaning derived from natural language processing.

**Interim recommendations**

1. Wherever refining an existing defining or qualifying relationship enables representation of the required meaning this approach should be preferred.
2. Where 1 does not meet the requirements any attribute which is used in the concept model for concepts of the same type may be applied. The value applied to the attribute must be one of the allowable values as specified for that attribute in the Concept Model Guide (6):

- For example a causative agent attribute can be applied to a clinical finding concept. The value assigned to this attribute is a value assigned from Organism, "physical force", "physical object" or substance. However, causative agent cannot be applied to refine a procedure. Furthermore the value of the causative agent cannot be a procedure or disorder.

3. Where neither 1 nor 2 meet the requirement use of additional attributes or values may be considered to meet a specific requirement. However, in this case, the implementer and/or user community will need to:

- Avoid a direct conflict with other uses of the same attribute.
- Ambiguity will arise if an existing attribute is overloaded to fulfil a different use-case:

  **Example:** The laterality attribute is used in the concept model to specify which of two functionally symmetrical paired structures is involved (e.g. "left wrist", "right kidney"). It should not be used for:

  - non-symmetrical structures (e.g. heart structures where the use of left and right refers to functionally different structures).
  - right or left side of a midline structure (e.g. head; laterality = left does not mean the "left side of the head" it means "left head" - and is thus not a useful refinement).
  - relative laterality (e.g. trachea; laterality = left does not mean "to the left of the trachea" or "trachea deviated to the left" it means "left trachea" - and is not a useful refinement).

- Agree the approach to be taken in advance:

  - Ad-hoc refinement by end-users without any guidance on an agreed approach is liable to lead to multiple ways of representing the same required meaning and a loss of interoperability.

- Document the approach taken in forms that:

  - Allow consistent use within the community;
  - Identify any issues related to computation of equivalence and subsumption between these local variant expressions and the content of SNOMED CT;
  - Are communicated to an appropriate SNOMED CT Working Group to help establish a wider consensus.

- Make provision for future migration of data as a common SNOMED CT approach is developed in future.

  **Note:** Within the UK, NHS Connecting for Health has issued guidance on post coordination which specifies constraints on allowable refinements and adds some specific extensions to the refinements sanctioned by released relationships. These guidance documents are available to implementers in the UK.

4.2.2.1.5 Applying values to concepts

Information model attributes such as values applied to an observable, also effectively refine the meaning of the concept as used in the record.

Currently the SNOMED CT Concept Model does not address issues of equivalence between a particular value applied to an observable or measurement procedure and a potentially similar finding (e.g. creatinine measurement, serum with a specified value and a finding such as serum creatinine raised). There is a loose approximation using the interprets and has interpretation Relationships between some clinical finding concepts and relevant observable entity or laboratory procedure concepts.
Example: | serum creatinine raised | has a definition that includes:

- | interprets |=| creatinine measurement, serum |
- | has interpretation |=| above reference range |

Future enhancements: The relationships between | observable entity |, | laboratory procedure |, | evaluation procedure | and | clinical finding | concepts are currently under review.

4.2.2.2 Modeling semantic context

When a clinical finding is mentioned in a patient record certain assumptions are usually made about what it means in relation to the person who is the subject of that record. Thus if the finding | wheezing | is present in a record it is assumed to mean that the subject of that record is wheezing at the time of examination. This assumed meaning might be stated in full "the subject of the record is currently wheezing" but a contracted form that omits explicit reference to the subject, timing and presence of the finding is more usual in written records.

Similarly when a procedure is mentioned in a patient record assumptions are usually made about what it means in relation to the subject of that record. Thus, in the absence of other information, the mention of the procedure | cholecystectomy | may be assumed to mean that a "the subject of the record had a cholecystectomy at a stated time ".

Although default assumptions such as those above may be made, it is also possible for mention of the same finding or procedure to have a very different meaning. For example, "past medical history of wheezing", "not wheezing", "father suffers from wheezing", | cholecystectomy planned |, | cholecystectomy not done |

The SNOMED CT context model provides a way to model concepts that explicitly state the clinical situation in which they are used. This same model also allows the construction of expressions that explicitly state the clinical situation in which a concept is being used in a particular record.

A proprietary record structure or a reference information model may also express aspects of context and these can be mapped to the SNOMED CT context model where appropriate to create comparable expressions.

The context model also specifies a default context that applies to findings and procedures which are expressed in a patient record without any explicit statement of context.

The most important aspects of the context model are those which have the potential to express a meaning that differs fundamentally from the meaning associated with the default context. Changes to context that have this fundamental effect on meaning are referred to as "axis modifying". The phrase "axis modifying" indicates a change that shifts the meaning between different axes in the subtype hierarchy.

The context model allows "axis modification" to be expressed within the general abstract logical model applied to all SNOMED CT concepts. To achieve this a concept such as | FH: Diabetes mellitus | is modelled as a subtype of | family history of disorder |. It is not a subtype of | diabetes mellitus | but instead its association with the finding | diabetes mellitus | is modelled using a defining relationship | associated finding |. Similarly a | Hip replacement planned | is a subtype of | planned procedure | (not a subtype of "hip replacement"). It is related to "hip replacement" by an | associated procedure | relationship.

4.2.2.3 Alternative logical abstract model views of expressions

Like a concept, an expression may be logically transformed into a variety of different views taking account of the definitions of the concepts which it references (i.e. the Concept Identifiers included in the expression).

4.2.2.3.1 Close-to-user expression view ("stated")

The close-to-user (or "stated") view of an expression contains references to the concept (or combination of concepts) together with refinements as selected by the user or as encoded by a clinical application to represent the semantics of a single clinical statement (i.e. a discrete clinical record entry).

The close-to-user view of an expression is the faithful representation of the information entered. For clinical safety and accountability purposes this should be regarded as the primary stored and communicated view of clinical information encoded using SNOMED CT.
Note: This view includes refinements applied by an application based on selections made in an entry form as well as those made explicitly. It does not include any relationships that are added based on classifier rules to make the expression complete or to normalise it.

4.2.2.3.2 Inferred expression views

An inferred expression can be derived from a stated expression by applying rules that take account of the definition of the refined concept and the associated refined values.

Inferences are drawn based on a consistent set of logical rules applied to the expression taking account of the definitions of concepts referenced by the expression.

Alternative semantically identical expressions may be generated using different logical transformations. The purpose of logical transformations is to support accurate and complete information retrieval through subsumption testing.

In general terms the types of transformation and resulting inferred views for expression are similar to those for concept definitions. The following sections of the guide identify some of inferred expression views and some of the differences between expressions and concept definitions.

4.2.2.3.3 Simple, nested and grouped expressions

A typical close-to-user expression consists of a single concept modified by optional refinements as shown in Figure 21. This may look like a concept definition but it is not defining the concept | hand pain |; it is specifying a more specific meaning by refining the | finding site | of the concept | hand pain | and adding a severity qualifier.

![Figure 21: Refining a concept to add specificity](image)

The target of a refinement may itself be refined producing a nested structure. An example of this is the application of laterality to finding site as shown in Figure 22.

![Figure 22: Nested refinement applied to a body site](image)

In some cases, refinements within an expression may be grouped to represent association between two different refinements. For example, a method and a target site or device as shown in Figure 23.
4.2.2.3.4 Expressions with multiple focus concepts

Some expressions may have multiple concepts followed by optional refinements as shown in Figure 24.

The base of an expression may thus be one or more supertype concepts that are combined to produce a single meaning.

It is important to note that combining concepts at this level presumes that the result is intended to be a single combined meaning which is subsumed by the meaning of the combined concepts. Furthermore, the same refinements apply to the combined meaning of this set of concepts.

Some representational forms (e.g. HL7 version 3 Concept Descriptor data type) do not allow combinations to be expressed in this way. However, it is possible to apply a simple logical transformation to create a semantically identical view that can be conveyed in a syntax that supports a single focus concept with refinements (see Figure 25).
4.2.2.3.5 Expressions that include context

*Expressions* may also explicitly represent the semantic context surrounding a finding or procedure. In these cases, the finding or procedure is nested inside the context component of the expression. The outer layer of the expression, which expresses the context, is sometimes referred to as the *context wrapper*. The nested expression representing the finding or procedure is sometimes referred to as the "clinical kernel".

*Figure 26* illustrates how the general concept 281666001 | family history of disorder | can be refined to represent family history of a specific condition.

*Figure 27* illustrates an alternative (computationally equivalent) representation of the same situation. In this case the family history situation is itself represented by an *expression*.

---

**Figure 25:** An alternative view of an expression with two focus concepts

**Figure 26:** Family history of a specific type of severe allergy to nuts as close-to-user form expression
4.2.2.3.6 Normal form expression view

The theoretical range of equivalent expressions for a single idea includes two end-points:

- A fully precoordinated expression in which a single concept identifier is used to represent the idea;
- A maximally postcoordinated expression in which every facet of the idea is separately represented by an attribute-value pair.

In between these end points are a variable number of equivalent partially postcoordinated expressions.

**Example:** For a detailed example see Example of equivalent postcoordinated expressions on page 75.

In order to compare expressions, it is useful to be able to transform from these varied expression into a common normal form expression. This is possible using the combination of the expression and the definitions of the concepts to which it refers. A long as a reference concept is fully defined the defining relationships for that concept can replace the concept identifier in the expression. This process reveals redundancies that can be removed by merging the definitions with the expression. An end-point is reached when all the concepts referenced by the expression are primitive. This is referred to as the normal form.

The process of normalisation of expressions is described in detail in Transforming expressions to normal forms on page 540.

**Note:** The most important requirements for logical transformation of expressions is to enable information entered (in a close-to-user view) to be readily tested for equivalence or subsumption against another expression or to test inclusion within constrained range of values.

4.2.2.3.6.1 Example of equivalent postcoordinated expressions

To illustrate the range of possible equivalent expressions Table 14 shows the defining characteristics of the hypothetical concept "red steel pedal bike" and its supertype ancestors.

---

3 This hypothetical concept is chosen in preference to a real SNOMED CT concept to allow illustration of theoretical points with simple qualifiers. While all the points illustrated apply to some SNOMED CT concepts.
Table 14: Definitions of concepts used in illustration of alternative representations

<table>
<thead>
<tr>
<th>Id</th>
<th>Concept</th>
<th>Defining Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Device (PRIMITIVE)</td>
<td>is a</td>
</tr>
<tr>
<td>2</td>
<td>Metal device</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>Made of = Metal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Transport device</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Steel transport device</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>is a</td>
<td>= Metal device</td>
</tr>
<tr>
<td></td>
<td>Made of = Steel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Pedal powered transport device</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power = Pedals</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bicycle (PRIMITIVE)</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moves on = 2 wheels</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Pedal bicycle</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>is a</td>
<td>= Bicycle</td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moves on = 2 wheels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power = Pedals</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Red pedal bicycle</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>is a</td>
<td>=Pedal powered transport device</td>
</tr>
<tr>
<td></td>
<td>Used as = Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moves on = 2 wheels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power = Pedals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Colour = Red</td>
<td></td>
</tr>
</tbody>
</table>

but there is no single concept that readily illustrates all these points without introducing other issues or having a long name that complicates the illustration.
<table>
<thead>
<tr>
<th>Id</th>
<th>Concept</th>
<th>Defining Characteristics</th>
</tr>
</thead>
</table>
| 9  | Steel pedal bicycle | is a | Pedal bicycle  
is a | Steel transport device  
Used as = Transport  
Moves on = 2 wheels  
Power = Pedals  
Made of = Steel |
| 10 | Red steel pedal bike | is a | Red pedal bicycle  
is a | Steel pedal bicycle  
Used as = Transport  
Moves on = 2 wheels  
Power = Pedals  
Made of = Steel  
Colour = Red |

Figure 28 illustrates a range of expressions based on each of the concepts defined in might be used to represent the concept "red steel pedal bike".

Expression K is a precoordinated expression using the concept "10 | red steel bike| ". Each of the other forms is postcoordinated by adding refinements that build on the concept definitions shown in Table 14.

These expressions would all be equivalent if the definitions were complete and accurate. In that case, it would possible to transform between them without losing information by appropriately adjusting the associated refinements to take account of the concept definitions. In practise the concept "bicycle" is marked as primitive which places a limit on transformation process.
Figure 28: Alternative expressions that mean "red steel pedal bicycle"

Two rules limit the range of equivalent expressions:

**Rule 1:** It is not possible to transform a **primitive concept** into a **postcoordinated expression**.

- A **primitive concept** has a facet that is not represented by its **defining characteristics** and therefore any attempt to represent it in a **postcoordinated** form results in a loss of information.

This is illustrated by consideration of the definitions of the **concept** "bicycle" in Table 14. The definition stated in the table is as follows:

| is a | "Transport device" , | Used as | = | Transport | , | Moves on | = | 2 wheels | , | Origin | = | Man made |

This definition would also apply to a horse-drawn cart or a trailer. Therefore the **concept** "bicycle" must be regarded as **primitive**. Recognising this fact means that some of the apparently equivalent **expressions** in Figure 28 cannot be computed as equivalent. Unless the **focus concept** is a **subtype** of "bicycle" it is not possible to compute that it is a kind of bicycle. This means that to create an equivalent **expression** it would be necessary to add | is a | = "Bicycle". This is shown in Figure 29.

Examining these definitions, it is apparent that the characteristics shown in grey are redundant because they are part of the definition of "bicycle."

As a consequence of this rule, **primitive concepts** create the limits on the ability to transform an **expression** to a more post-coordinated form. An **expression** can be normalised until all the **concepts** referred to by the **expression** are **primitive**. An **expression** in which all the referenced **concept** are **primitive** is referred to as the **normal form**.
Rule 2: It is not possible to transform a *postcoordinated expression* into a fully *precoordinated concept* unless such a concept already exists in the released terminology.

This second rule is perhaps self-evident but it is stated because, like the first rule, it alters the available representations. If the concept "red steel pedal bicycle" was not available in a *precoordinated* form, there are two distinct expressions that are as *precoordinated* as possible (i.e. "steel pedal bicycle" + "colour" = "red" and "red pedal bicycle" + "made of" = "steel"). This is illustrated in Figure 30. In such cases there is no obvious reason to prefer one compared to the other.

**Figure 29: Expressions meaning "red steel pedal bicycle" with "bicycle" recognised as primitive**
4.3 Representational Forms

This section describes different ways in which SNOMED CT components, derivatives and expression can be represented. These representations include the files in which SNOMED CT is distributed as well as possible representations that may be used assist implementation or optimise particular functions.

4.3.1 Release Files

SNOMED CT is provided to licensees as a set of release files. The file naming conventions and the structure of these files is described in Release File Specifications (5) in a separate section of this guide. There are currently two distinct Release Formats:

- **Release Format 1 (RF1)**: The specification in which SNOMED CT has been provided since its first release in 2002 (with a few minor amendments).
- **Release Format 2 (RF2)**: Based on a draft trial specification that adds a range of significant enhancements.

4.3.2 Representing SNOMED CT identifiers

Components within SNOMED Clinical Terms are identified and referenced using numeric Identifiers. These Identifiers have the data type SCTID (SNOMED CT Identifier).

The SCTID data type is 64-bit integer which is allocated and represented in accordance with a set of rules. These rules enable each Identifier to refer unambiguously to a unique component. They also support separate partitions for allocation of Identifiers for particular types of component. In the case of components that originate in an Extension, the Identifier also supports separate namespaces that distinguish between different issuing organisations.
4.3.2.1 SCTID Data Type

The **SCTID** data type is a 64-bit positive integer.

When rendered as a string an **SCTID** must always be represented using decimal digits and when rendered as a string has a maximum permitted length of 18 digits and a minimum length of 6 digits.

> **Note:** Leading zeros are always omitted from the string rendering of an **SCTID**. For example the value "101291009" must **not** be rendered as "0101291009".

### 4.3.2.2 SCTID Representation

Each **SCTID** identifies a **SNOMED CT component**. The **Identifier** itself does not contain information related to the meaning of a **concept** or **description**. This means it is not possible to infer anything about the meaning of a **concept** from the numeric value of the **Identifier** or from the sequence of digits in that form of the identifier. The meaning of a **concept** can be determined from relationships to other **concepts** and from associated **descriptions** that include human readable terms.

The **SCTID** does however have a structure which includes valuable information about the nature and source of the identified component and the validity of the **Identifier**. This structure supports the following features:

- **Check-digit validation of the **Identifier**.**
  - The **check-digit** is the final digit in the decimal rendering of the **Identifier**. This can be checked to minimise errors from transcription or incomplete copy-paste actions.

- **Partitioning between Identifiers for different types of **SNOMED CT component**.**
  - A two-digit **partition-identifier** distinguishes the **Identifiers** of different component types and prevents the same **Identifier** from being allocated to both a **concept** and a **description**. As a result, when an **SCTID** is read from a record or other resource, it is possible to determine whether it represents a **concept**, a **relationship** or a **description**, before searching for the identified component.

- **Namespaces to separate component **Identifiers** originated by different organisations.**
  - Organisations are only permitted to issue **Identifiers** which fall within a specified namespace of potential **Identifier** values. This prevents collisions between **Identifiers** issues by different organisations which would otherwise result in ambiguity and errors when sharing data.

- **There are two formats used for representing namespaces.**
  - Short format in which **partition-identifiers** are reserved for an organisation which is permitted to issue any valid **Identifiers** within the allocated partitions. The short format approach does not require a specific **namespace-identifier** and is only applicable to components originated and maintained by the **IHTSDO** as part of the **International Release** of **SNOMED CT**.
  - Long format in which the **partition-identifier** value indicates that a separate **namespace-identifier** is required to distinguish between components originated as part of an **Extensions** created by an appropriately authorised organisation.
**Note:** The IHTSDO allocates namespace-identifiers to organisations such as IHTSDO Members and Affiliates to enable them to create content and or derivatives in an Extension. The namespace-identifiers enables unique SCTIDs to be issued by many organisations and allow each SCTID to be traced to an authorised originating organisation.

### 4.3.2.3 SCTID Constraints

The permissible value for the SCTIDs are limited by the following rules:

- Only positive integer values that are greater than $10^5$ and less than $10^{18}$ are permitted.
- The only valid string renderings of the Identifier value are strings of decimal digits (0-9), commencing with a non-zero digit.
- The second and third digits from the right hand end of the string rendering of the Identifier must match one of the partition-identifier values specified in this guide.
- The rightmost digit of the string rendering is a check-digit and must match the value calculated using the specified check-digit computation.
Notes:

1. As a result of these rules, many 64-bit integers are not valid SCTIDs. The value limitations enable any valid SCTID to be stored in either a signed or unsigned 64-bit integer.
2. The rules also ensure that an SCTID can be distinguished from code from one of the antecedent code systems Read Codes (which are 4 or 5 characters in length) and legacy Identifiers from SNOMED RT and it predecessors (which always start with a letter).
3. SNOMED RT identifiers are SCTIDs identical to those used in SNOMED CT but in some cases will now refer to inactive concepts. In these cases, data in the 900000000000489007 | Concept inactivation indicator reference set | and 900000000000522004 | Historical association | Reference sets can be used to find the identifier of the closest equivalent active concept.

4.3.2.4 Check-digit

The final (units) digit of the SCTID is the check-digit. It is not envisaged that users will be routinely required to type SCTID values. However, the objective of the check-digit is to detect the commonest types of error that may occur due to typographical errors on those occasions where transcription or communication mechanisms may introduce error. Examples may include high-level development such as creating or modifying protocols or pre-specified queries.

An SCTID is checked by using the "Verhoeff check", which is a Dihedral D 5 Check. This detects a higher proportion of common typographical errors than either the IBM or Modulus 11 check. Unlike the Modulus 11 check it is effective on decimal strings longer than ten-digits. Furthermore its value can always be represented as a decimal digit without excluding any values.

See Check-digit computation for detailed information about the Verhoeff check-digit and sample program code.

4.3.2.5 Partition identifier

The penultimate two-digits of the SCTID (second and third from the right), are the partition-identifier.

The partition-identifier indicates the nature of the component identified. This allows the Identifier of a Description to be distinguished from the Identifier of a Concept.

The partition-identifier also indicates whether the SCTID contains a namespace-identifier (long format) or follows the short format applicable to Identifiers of components that originated in the International Release.

Identifiers of components that originated in the International Release of SNOMED CT have one of the following partition-identifier values:

Table 15: partition identifier Values for Short Format SCTIDs

<table>
<thead>
<tr>
<th>PartitionId</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>A Concept</td>
</tr>
<tr>
<td>01</td>
<td>A Description</td>
</tr>
<tr>
<td>02</td>
<td>A Relationship</td>
</tr>
</tbody>
</table>

Identifiers of components that originated in an Extension have one of the following partition identifier values:
All other partition-identifier values are reserved for future use.

### 4.3.2.6 Namespace-Identifier

If the partition-identifier indicates a long format SCTID, the seven-digits immediately to the left of the partition-digit are a namespace-identifier. The namespace-identifier is an integer value, left padded with '0's as necessary to ensure there are always seven digits in the value. The namespace-identifier does not hold meaning.

Each organisation that is authorised to generate SCTIDs is allocated a namespace-identifier by the IHTSDO. Each allocated namespace is represented in the Namespace Concept metadata sub-hierarchy, released as part of the International release (see details in The Namespace hierarchy).

### 4.3.2.7 Item-identifier digits

The string of digits to the left of the partition-identifier (in a short format SCTID) or to the left of the namespace-identifier (in a long format SCTID) is referred to as the item-identifier. These values are available to uniquely identify an individual entity within the specified partition or namespace. The same item-identifier can be allocated in each partition of each namespace as the SCTID is rendered unique by the partition-identifier and the namespace-identifier.

For components in the International Release of SNOMED CT, item-identifiers will usually be issued in the arbitrary order in which components are added to SNOMED Clinical Terms. However, due to management of the editing process the sequence of issued item-identifiers may be discontinuous.

**Caution:** In all cases, the value of item-identifier on it is meaningless. The only way to determine the meaning of an SCTID is by looking up the complete value in an appropriate distribution file.

### 4.3.2.8 Example SNOMED CT identifiers

The following examples conform to the SNOMED CT identifier specification and illustrate a range of possible Identifiers within different partitions and namespaces.

<table>
<thead>
<tr>
<th>SctId</th>
<th>Partition identifier</th>
<th>Check digit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>100005</td>
<td>00 = Concept, using short format</td>
<td>5</td>
<td>The Item Identifier digits ‘100’ are the lowest permitted value. Therefore this is the lowest SctId that can be allocated to a Concept.</td>
</tr>
<tr>
<td>100014</td>
<td>01 = Description, using short format</td>
<td>4</td>
<td>This is the lowest SctId that can be allocated to a Description.</td>
</tr>
<tr>
<td>100022</td>
<td>02 = Relationship, using short format</td>
<td>2</td>
<td>This is the lowest SctId that can be allocated to a Relationship.</td>
</tr>
</tbody>
</table>
### The Namespace hierarchy

*SNOMED CT* core release files include metadata *Concepts* that represent each of the allocated *namespace-identifiers*. The *Concepts* representing the namespaces are arranged in a single parent hierarchy, as follows:

- 370136006 | Namespace concept |
  - 373872000 | Core Namespace |
    - | Extension Namespace A {} |
    - | Extension Namespace B {} |
      - | Extension Namespace D {} |
      - | Extension Namespace E {} |
    - | Extension Namespace C {} |

#### Figure 33: Hierarchy for: Namespace concept (namespace concept)

In the above hierarchy, | Extension Namespace A {} |, | Extension Namespace B {} | and | Extension Namespace C {} | are all child namespaces of the 373872000 | Core Namespace | (representing the

<table>
<thead>
<tr>
<th>SctId</th>
<th>Partition identifier</th>
<th>Check digit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290023401004</td>
<td>00=Concept, using short format</td>
<td>9</td>
<td>A valid SctId for a Concept.</td>
</tr>
<tr>
<td>1290023401015</td>
<td>01=Description, using short format</td>
<td>5</td>
<td>A valid SctId for a Description.</td>
</tr>
<tr>
<td>9940000001029</td>
<td>02=Relationship, using short format</td>
<td>9</td>
<td>A valid SctId for a Relationship.</td>
</tr>
<tr>
<td>1000001105</td>
<td>10=Concept, using long format</td>
<td>5</td>
<td>A valid long format SctId for a Concept in the 0000001 namespace.</td>
</tr>
<tr>
<td>10989121108</td>
<td>10=Concept, using long format</td>
<td>8</td>
<td>A valid long format SctId for a Concept in the 09891211 namespace.</td>
</tr>
<tr>
<td>1290989121103</td>
<td>10=Concept, using long format</td>
<td>3</td>
<td>A valid long format SctId for a Concept in the 0989121 namespace.</td>
</tr>
<tr>
<td>129000001117</td>
<td>11=Description, using long format</td>
<td>7</td>
<td>A valid long format SctId for a Description in the 0000001 namespace.</td>
</tr>
<tr>
<td>994000001126</td>
<td>12=Relationship, using long format</td>
<td>6</td>
<td>A valid long format SctId for a Relationship in the 0000001 namespace.</td>
</tr>
<tr>
<td>99999990989121104</td>
<td>10=Concept, using long format</td>
<td>4</td>
<td>The maximum valid SctId for a Concept in the 0989121 namespace.</td>
</tr>
</tbody>
</table>
International edition which does not have a namespace-identifier, and uses short format SCTIDs to identify components). Also, | Extension Namespace B {} | is the parent namespace of | Extension Namespace D {} | and | Extension Namespace E {} |

Each Namespace concept may only have one parent Namespace concept in the 370136006 | Namespace concept | sub-hierarchy.

The namespace hierarchy is used to constrain which content can be promoted from one Extension to another without amending the SCTID. Content may be moved (without amendment of SCTID) from an Extension released by the owner of a child namespace to an Extension released by the owner of a parent (or ancestor) namespace, as described by the |370136006 | Namespace concept | sub-hierarchy.

Examples:

1. A concept with an SCTID that includes | Extension Namespace D {} | may be moved to the Extension maintained by the owner of | Extension Namespace B {} | because this is a parent of the originating namespace.
2. A concept with an SCTID that includes | Extension Namespace D {} | must not be moved to the Extension maintained by the owner of | Extension Namespace C {} | because this is not parent (or ancestor) of the originating namespace. Therefore, to make this move the original concept must be inactivated and replaced by a new component with a new SCTID in target namespace.
3. Any concept may be moved from any Extension to the International Release (subject only to formal acceptance that is a valid addition for international use).

Namespace concepts have the following characteristics:

- They are subtypes (either children or descendants) of 370136006 | Namespace concept |.
- The Fully Specified Name of each Concept has the form “Extension Namespace {nnnnnnn} (namespace concept)” – where nnnnnnn is the seven digit Namespace-Identifier.
- A Synonym associated with each Concept has the form “Extension Namespace nnnnnnn”
- Where appropriate further Synonyms may be included to identify the nature of the responsible organisation.

When requesting a namespace-identifier from IHTSDO, there will be a facility to optionally specify a parent Namespace-identifier for the new namespace.

To specify a parent namespace for an existing namespace-identifier, please contact info@ihtsdo.org with details of your existing namespace-identifier and its proposed parent namespace-identifier.

Caution: Once a namespace-identifier has been allocated a parent namespace-identifier in this hierarchy, further changes to this hierarchical Relationship are not permitted. This restriction is imposed to avoid changes that would undermine traceability of moves between namespaces.

4.3.3 Representing Extensions

4.3.3.1 Extension Tables - Structure

Extensions use the same table structure as the Concepts, Descriptions, Relationships, and Reference Sets tables defined in those respective sections of this manual. These tables have the same structure or schema as the core tables but are in separate files.

When packaged, extension file names should follow the conventions defined by the IHTSDO. For more information, refer to the document SNOMED CT File Naming Convention.

4.3.3.2 Specification for Namespace within the SCTID

The identifiers assigned to all components that originated as part of an extension include a namespace-identifier (see Representing SNOMED CT Identifiers). This means that the sets of Identifiers available to each organisation authorised to issue components are distinct, which ensures that the same Identifier cannot be issued by two different organisations.
All Extension components (rows) originated by an organisation must use the Namespace Identifier assigned to that organisation. Namespace Identifiers are issued by the IHTSDO so that the Namespaces remain unique between organisations. Allocated Namespaces are recorded as Concepts in the SNOMED CT Model Component hierarchy ("special concepts" hierarchy in RF1) when they are issued to an organisation.

Namespaces serve three Roles:
- Preventing collision or reuse of SNOMED CT identifiers;
- Indicating the origin of a component. In RF2 responsibility for maintenance is tracked only by the ModuleId, this is the field that should be used to avoid potential risk of two organisations make conflicting changes to the same component.
- Indicating the source for information about a concept - relevant for Extension Concepts that are not directly available in a particular system.

All Extension components (rows) should use the appropriate partition-identifiers for Extensions. This ensures that components of the SNOMED CT International Release can be distinguished from components that are part of an Extension.

Note: Components that originate as part of the International Release do not have a namespace field and are distinguished instead by partition-identifier values that are specific to International Release.

Note: Each organisation can assign the item-Identifier portion of the SCTID in any way within its Namespace. If there is a need to allocate part of the development process to a subdivision within an organisation, they may be allocated a set or range of item-identifiers that have not yet be used or allocated within that Namespace. The authorised organisation must ensure that it tracks and manages all such allocations in a way that avoids any risk of reuse of the same SCTID.

4.3.3.3 Namespace allocation

Namespace-identifiers are allocated by the IHTSDO to licenced organisations. The IHTSDO is under no obligation to allocate a namespace to any organisation and makes these allocations at its discretion.

Allocation of a namespace does not imply any endorsement of the reputation of an organisation nor to the quality or fitness for purpose of any Extensions created by that organisation. Users and/or vendors incorporating Extensions into their application do so at their own risk and should satisfy themselves with the reputation of the responsible organisation and the quality the Extensions so incorporated.

4.3.3.3.1 Namespace Allocation Policy/Regulation

Title: Namespace Allocation Policy/Regulation

Effective Date: August 4, 2009 Owner: Management Board

Date Last Reviewed: October 14, 2009 Date Last Revised: October 14, 2009
4.3.3.3.1.1 Regulation Statement

*IHTSDO* will allocate *SNOMED CT Namespace Identifiers* upon written request from a Member or an Affiliate in accordance with the procedures outlined below. The *IHTSDO* will also maintain and publish a register of *Namespace Identifiers* issued.

Section 9 of the Articles of Association provides the starting point for the *Namespace Allocation Policy*. It states that:

- 9.1 Only the Association may issue *Namespace Identifiers*.
- 9.2 The Association shall, upon written request from a Member or an Affiliate in accordance with such procedures as the Association may prescribe by Regulations, issue one or more *Namespace Identifiers* to the Member or Affiliate. The Association shall not unreasonably refuse to issue a *Namespace Identifier* to a Member or an Affiliate.
- 9.3 The Association shall be responsible for ensuring that each *Namespace Identifier* is only issued to a single Member or Affiliate.

In addition, section 7.1.7 states that "An Affiliate may not create any Standards-Based Third Party Extension or any Standards-Based Derivative from the Member's National Extensions unless that Affiliate has been issued with a *Namespace Identifier*.”

4.3.3.3.1.2 Definitions

**Affiliate**: An Affiliate of *IHTSDO* in accordance with *IHTSDO*'s Articles of Association, i.e. a person or organisation to which the *International Release* of *SNOMED CT* (whether on its own or as part of a Member's *National Release* of *SNOMED CT*) is distributed or otherwise made available under the Articles of Association.

**Namespace Identifier**: A code or that part of a code that identifies the organisation responsible for creating and maintaining a standards-based *extension* or a standards-based *derivative*. It is an element of *SNOMED CT conception Identifiers*.

4.3.3.3.1.3 Context

*Namespace Identifiers* are 7-digit numbers that *IHTSDO* issues to those who create *extensions* to *SNOMED CT*, such as national *extensions*. *Namespace identifiers* ensure that it is clear who developed and maintains particular customised terminology. They also ensure that terminology in *SNOMED CT extensions* has unique *Identifiers* but a common structure, which facilitates application development and the creation of *Reference Sets*. There is a defined process for management of *Namespace Identifiers* when terminology is moved between *extensions* or from an *extension* into the *International Release*.

It should be noted that this policy covers the technical mechanism to allocate *Namespace Identifiers* in order to be able to identify the source of content, prevent collisions in terminology that would affect interoperability, and achieve similar goals. It does not cover whether or not particular types of content, including *extensions* and *derivatives*, can be used in a given context. This may be the subject of national policies, guidelines, or other documents. Requesters of a *Namespace Identifier* are encouraged to review *SNOMED CT International Release* documentation and to consult with *IHTSDO Members* in countries in which deployment of any content developed in the *Namespace* is planned for additional guidance, policy, and/or process documents which may be relevant.

4.3.3.3.1.4 Procedures

4.3.3.3.1.4.1 Informing the Community of Practise:

*IHTSDO* will inform the Community of Practise about the process for requesting a *Namespace Identifier*.

- A copy of this regulation will be posted to the *IHTSDO* website.
- Instructions for requesting a *Namespace Identifier*, including the form for making such a request, will be posted to an appropriate location on the *IHTSDO* website (e.g. the Frequently Asked Question or "How do I?" pages).
- Confirm which Members would like to be notified when one of their Affiliates requests a *Namespace*, i.e. an Affiliate listing an address in the jurisdiction in question on their *Namespace Identifier Application Form* and/or who identified that they received their Affiliate Licence through that jurisdiction.
4.3.3.3.1.4.2 Requesting & Granting a Namespace:

The Association shall, upon written request from a Member or an Affiliate in accordance with such procedures as the Association may prescribe by Regulations, issue one or more Namespace Identifiers to the Member or Affiliate. The Association shall not unreasonably refuse to issue a Namespace Identifier to a Member or an Affiliate.

- To request a Namespace Identifier, individuals/organisations should complete and submit a copy of the Namespace Identifier Application Form by email to support@ihtsdo.org.
- IHTSDO should verify that the requester is either:
  - An IHTSDO Member
  - An individual or organisation who holds a valid Affiliate Licence
  - An individual or organisation who does not fall into the above categories but whose application is approved in writing by the IHTSDO

If the conditions above apply, IHTSDO should issue a unique Namespace Identifier to the requester if:

- The request is from an IHTSDO Member;
- The request is from the holder of a valid Affiliate Licence, is for a single Namespace Identifier, and the requester has not already been issued a Namespace Identifier; OR;
- IHTSDO's CEO approves the request in writing.

The issuance of the Namespace Identifier should be confirmed in writing with the requester, along with a link to this policy and a reminder that they will be contacted annually to reconfirm their contact information and potentially provide additional information to be published in the register. Requesters should also be provided with Member contact information and the recommendation that they should contact relevant Members to obtain any additional national guidance, policy, and process documents which may be relevant.

The relevant Member should be informed if they have requested to be notified when an Affiliate from their jurisdiction requests a Namespace, i.e. an Affiliate listing an address in the jurisdiction in question on their Namespace Identifier Application Form and/or who identified that they received their Affiliate Licence through that jurisdiction.

4.3.3.3.1.4.3 Format of Namespace Identifiers:

- Namespace Identifiers are 7 digit numeric codes;
- Namespace Identifiers are issued in sequence, unique, and not re-used.

4.3.3.3.1.4.4 Maintaining and Publishing a Namespace Register:

IHTSDO will maintain and publish an up-to-date Namespace Register.

- When Namespace Identifiers are allocated, a record of the number of that Identifier, the date of issuance, the body from which the Affiliate Licence was obtained (if applicable), and the name and contact information of the individual/organisation to which it was issued will be added to the Namespace Register.
- On an annual basis, IHTSDO will contact all those to whom Namespace Identifiers have been issued by email to confirm contact information. A reminder will be sent after 30 days if a response has not been received. The year in which a confirmation of current contact information was last received will also appear in the Namespace Register.
- IHTSDO reserves the right to make a Namespace Identifier inactive for current and future use (i.e. it cannot be used for newly-created concepts from that point onward) if the individual or organisation to which it was issued cannot be contacted after three attempts. This status will be noted in the Namespace Register and the individual or organisation to which the Namespace Identifier was issued will be notified accordingly.
- IHTSDO also reserves the right to make a Namespace Identifier inactive if (1) it is requested to do so by the organisation to which the Namespace Identifier was issued, (2) the organisation to which the Namespace Identifier was issued is involved in a merger or acquisition with another organisation to which a Namespace Identifier has been issued, or (3) it receives a written complaint about the use of that Namespace that, upon investigation, it determines to be well-founded, according to the protocol for material breaches and termination of Affiliate Licences identified in clause 5.2 of the Affiliate Licence.
• The Namespace Register will be published with each version of the SNOMED CT International Release. In the future, IHTSDO reserves the right to also publish the Namespace Register on the IHTSDO website.

4.3.3.1.5 References

• IHTSDO Articles of Association;
• SNOMED CT Technical Implementation Guide;
• IHTSDO Namespace Identifier Application Form.

4.3.3.1.6 Document Control

This policy was approved by the IHTSDO Management Board on August 4, 2009 and is subject to regular review according to IHTSDO’s policy review processes. Key stakeholders include the Technical Committee, the Implementation and Innovation Committee, the Member Forum, and the Affiliate Forum.

4.3.3.4 Component Guidelines

Descriptions that are part of an Extension can refer to either a Concept that is part of that Extension, a Concept that is part of another Extension, or an International Release Concept.

Relationships that are part of an Extension can relate two Concepts in the Extension or two Concepts in different Extensions. The relationship can also relate the extension Concept to an International Release Concept— that is, sourceId is in the extension and destinationId is in the International Release.

4.3.3.5 Content of Extensions

The components in an Extension have the same structure as International Release components of SNOMED CT.

SNOMED CT International Release is not dependent on availability of any Extension. However, all SNOMED CT Extensions are dependent on the SNOMED CT International Release. Some Extensions may also be dependent on other Extensions. Dependencies between Extensions must be declared and must not be circular.

The following rules apply to dependencies between components and derivatives in Extensions.

Note: In these rules,

• Containing-Extension, refers to the Extension that contains the named component or derivative.
• Dependee-Extension, refers to another Extension on which the Containing-Extension is dependent.

1. Every Concept in an Extension:
   • Must be a subtype descendant of an International Release Concept:
     • This descent may be indirect, passing through Concepts in either the Containing-Extension or a Dependee-Extension.

2. Every Description in an Extension:
   • Must apply to a Concept, in the one of the following Namespaces: the Containing-Extension, the International Release or a Dependee-Extension.

3. Every defining Relationship in an Extension:
   • Must define a sourceId which refers to a Concept in the Containing-Extension.
     • In exceptional circumstances, an Extension may add additional defining attributes to a Concept in the International Release or a Dependee-Extension.
   • Must have typeId which refers to a Concept, in the one of the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.
   • Must have a destinationId which refers to a Concept, in the one of the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.
4. A Reference Set in an Extension:
   • May include references to components and derivatives in any of the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.

5. The enumerated values used in RF2 components that form part of an Extension must be all be represented by metadata Concepts that are present in one of the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.

The following additional rules are only relevant to Extensions represented using Release Format 1:

   • Reference Sets in an Extension:
     • May include as its members Components from the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.
     • May refer to other Reference Sets in the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.
     • May provide maps for Concepts from the following Namespaces: the Containing-Extension, the International Release, or a Dependee-Extension.

4.3.3.6 Transfer of Responsibility between Organisations

When the need arises to transfer components (Concepts, Descriptions, Relationships) from the International Release content to an Extension, from an Extension to the International Release, or from one Extension to another, conversation and coordination between the sending and receiving organisations is needed. In some cases, entire tables may be transferred - not just individual components.

It should be noted that the transfer of components among Extensions, or between an Extension and the International Release, is subject to the terms of the IHTSDO Affiliate Licence and, within an IHTSDO Member country, may also be subject to the terms of that Member's SNOMED CT national licence.

Examples of transfers include:

   • From the SNOMED CT International Release to an organisation responsible for an Extension:
     • This occurs if a decision is made that some Concepts in the International Release are specific to a Realm or domain or interest for which another organisation has been allocated responsibility:
       • For example, this applies to UK specific drugs and UK specific administrative Concepts which are maintained by the UK NHS.

   • From an organisation responsible for an Extension to the International Release:
     • This occurs if an organisation recognises that some of its Extension content belongs in the International Release as it has general applicability;
       • It also occurs if an organisation hands over responsibility for its entire Extension to the IHTSDO.

   • From one organisation responsible for an Extension to another organisation:
     • This occurs if one organisation recognises that some of its Extension content belongs in a domain managed by another organisation;
       • It also occurs if an organisation hands over responsibility for its entire Extension to another organisation.

There are three types of transfer of responsibility:

   • Transfer of an entire Extension (i.e. all components ever issued with an SCTID in a given Namespace from one organisation to another organisation):
     • This is a straight forward process. All that happens is that another organisation assumes responsibility for the original Namespace-identifier. There is no need for detailed tracking of individual components.

   • Transfer of one or more components from an Extension to the International Release or to a "parent"Extension:
As a result of revised guidance on SNOMED CT Identifier Updates, since 2011, some transfers can be made without changing the Identifier of the component provided that the RF2 format moduleId field is used to denote that the component is now being issued as part of a different module.

- Transfer of one or more components between other Extensions or from the International Release to any Extension:
  - In this case, the Namespace is not transferred and thus, to fulfil the roles of the Namespace-Identifier, the component must be assigned new SCTIDs in the Namespace of the newly responsible organisation:
    - The previous instances of these components are withdrawn from current use with the Status value Moved Elsewhere;
    - Appropriate Relationships point to replacement components in the new Namespace.

The transfer of responsibility depends on the release schedules of the organisations involved. Often the original source organisation will be aware of an intended move before the target organisation has accepted responsibility and released the component. To facilitate this, an interim Status value Pending Move is applied to components that are being moved to another Namespace but are intended for active use until their replacements are found in the target Namespace.

To provide continuity for a Concept if responsibility is transferred, Concept versioning and supporting files are coordinated as follows:

Table 17: Processing Transfers between Extensions

<table>
<thead>
<tr>
<th>Start State</th>
<th>Sending Organisation</th>
<th>Receiving Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConceptA</td>
<td>Active = 1</td>
<td></td>
</tr>
<tr>
<td>Agreement to transfer responsibility</td>
<td>ConceptA</td>
<td>Active = 1</td>
</tr>
<tr>
<td></td>
<td>900000000000489007</td>
<td>Concept inactivation indicator reference set</td>
</tr>
<tr>
<td></td>
<td>900000000000492006</td>
<td>Pending move</td>
</tr>
<tr>
<td></td>
<td>900000000000524003</td>
<td>MOVED TO association reference set</td>
</tr>
<tr>
<td></td>
<td>ConceptA-&gt; Namespace 99999999</td>
<td></td>
</tr>
</tbody>
</table>

Note: Namespace 99999999 is recorded in the SNOMED CT Concepts File. Therefore, the Sending Organisation can track the organisation to which the concept has moved, even if the new Concept Identifier is not yet assigned.

Assume assigned namespace = 9999999
<table>
<thead>
<tr>
<th>Responsibility Transferred</th>
<th>Sending Organisation</th>
<th>Receiving Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ConceptA</td>
<td>ConceptB (created as replacement for ConceptA)</td>
</tr>
<tr>
<td></td>
<td>• Active = 0</td>
<td>• Active = 1</td>
</tr>
<tr>
<td></td>
<td>9000000000000489007</td>
<td>9000000000000525002</td>
</tr>
<tr>
<td></td>
<td>• ConceptA - value: 900000000000487009</td>
<td>• ConceptB -&gt; ConceptA</td>
</tr>
<tr>
<td></td>
<td>9000000000000524003</td>
<td>Note: The Receiving Organisation can record the Concept Identifier previously used for the concept.</td>
</tr>
<tr>
<td></td>
<td>MOVED TO association reference set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ConceptA -&gt; Namespace 9999999</td>
<td></td>
</tr>
</tbody>
</table>

### 4.3.3.7 Released Extensions

The following extensions are included in the International Release of SNOMED CT from the IHTSDO. As with any extension, their content may not be suitable for use everywhere, and users should consult with their National Release Centre for information regarding the use of extension content within an IHTSDO Member country.

**Table 18: Released Extensions**

<table>
<thead>
<tr>
<th>Extension</th>
<th>Distribution</th>
<th>Extension Contents</th>
</tr>
</thead>
</table>
| U.S. Drug Extension | International Release | Actual manufactured drugs approved for distribution in the United States at the "actual medicinal product" (AMP) level. The AMP is a syntactic normal form consisting of:
- Name (Proprietary);
- Strength;
- Dosage Form.
All AMPs relate to "virtual medicinal product" (VMP) concepts in the SNOMED CT Core. All AMPs include the "has active ingredient" relationship where the active ingredient is a substance in the SNOMED CT Core. |

### 4.3.4 Representational Forms for Expressions

#### 4.3.4.1 SNOMED CT compositional grammar

The SNOMED Composition Grammar is a lightweight syntax for representation of SNOMED CT expressions. It is has been proven to be both human readable and machine parsable.

#### 4.3.4.1.1 Background

##### 4.3.4.1.1.1 Prior versions and status of revision

The SNOMED Composition Grammar was initial specified as part of the document "SNOMED Clinical Terms Abstract Logical Models and Representational Forms, External Draft..."
for Comment Version”. This was used extensively and was proven to be both human readable and machine parsable.

The current specification which has now been adopted as an IHTSDO Standard, follows the prior version in most details. It includes the following enhancements:

1. The syntax of the grammar specification is now Augmented Backus-Naur Form (ABNF) which provides a formal standards-based reference for the grammar’s structure.
2. Unnecessary whitespace designators, <ws>, were removed from several places in the grammar.
3. The maximum length constraint for SNOMED Clinical Terms Identifiers (SCTIDs) is added to this grammar. SCTIDs consist of sequences of digits, from a minimum of 6 to a maximum of 18 digits in length.
4. The hex code for carriage return (CR) was incorrectly given as ‘0C’ in the previous version. It is corrected to ‘0D’ in this version.
5. Detailed character encoding information for UTF-8 is added.
6. The definition of term has been amended to allow correct parsing by the APG parser generator.

4.3.4.1.1.2 Compositional Grammar and the HL7 Code data type

The SNOMED CT compositional grammar allows SNOMED CT expressions to be represented as a text string that can be carried in HL7 version 3 messages, in the Code data type. In particular, the grammar is intended to replace the qualifier mechanism that formerly was in the HL7 Concept Descriptor data type (CD data type), and which was removed in the HL7 version 3 data types Release 2.

In May 2008, the HL7 Version 3 Standard “Data Types - Abstract Specification, Release 2” was released for Normative Ballot 2.

This revised standard defined what can be carried in the Code data type as "the plain code symbol defined by the code system, or an expression in a syntax defined by the code system which describes the concept."

The following details are quoted from the HL7 Version 3 Standard: Data Types - Abstract Specification, Release 2, Normative Ballot 2 - May 2008 (HL7 V3 DT R2), section 4.5.1 "Code (code): ST.SIMPLE":

**Table 19: Code definition from HL7 Data Types Release 2**

<table>
<thead>
<tr>
<th>Code (code)</th>
<th>ST.SIMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition:</td>
<td>The plain code symbol defined by the code system, or an expression in a syntax defined by the code system which describes the concept. (emphasis added)</td>
</tr>
</tbody>
</table>

If provided, the code SHALL be an exact match to a plain code symbol or expression defined by the code System. If the code system defines a code or expression that includes whitespace, the code SHALL include the whitespace.

**An expression can only be used where the code System either defines an expression syntax, or there is a generally accepted syntax for the code System.** (emphasis added)

The syntax described herein is intended to satisfy the need for a "syntax defined by the code system" as stated above, when the "code System" is SNOMED CT.

---

5 ABNF as defined by Internet Standard 68, RFC 5234
6 http://www.hl7.org/v3ballot/html/infrastructure/datatypes_r2/datatypes_r2.htm
4.3.4.1.2 Compositional grammar: Normative specification

Table 20: ABNF definition of the SNOMED CT compositional grammar

| expression = concept *("+" concept) [":" ws refinements ]
| concept = ws conceptId ws ["]" ws term ws "]" ws]
| conceptId = scId
| term = 1*nonwsnonpipe *( 1*SP 1*nonwsnonpipe )
| refinements = ( attributeSet *attributeGroup ) / 1*attributeGroup
| attributeGroup = "{" attributeSet "}" ws
| attributeSet = attribute *("","" attribute)
| attribute = attributeName "=" attributeValue
| attributeName = ws attributeNameId ws ["|"] ws term ws "]" ws]
| attributeValue = concept / ( ws "(" expression ")" ws)
| attributeNameId = scId
| scId = digitNonZero 5*17( digit )
| ws = *( SP / HTAB / CR / LF ) ; white space
| SP = %x20
| HTAB = %x09
| CR = %x0D
| LF = %x0A
| digit = %x30-39
| digitNonZero = %x31-39 ; digits 1 through 9, but excluding 0
| nonwsnonpipe = %x21-7B / %x7D-7E / UTF8-2 / UTF8-3 / UTF8-4
| UTF8-2 = %xC2-DF UTF8-tail
| UTF8-3 = %xE0 %xA0-BF UTF8-tail / %xE1-EC 2( UTF8-tail ) / %xED %x80-9F UTF8-tail / %xEE-EF 2( UTF8-tail )
| UTF8-4 = %xF0 %x90-BF 2( UTF8-tail ) / %xF1-F3 3( UTF8-tail ) /
| UTF8-tail = %x80-BF

4.3.4.1.3 Informative comments

Table 21: BNF representation of Compositional Grammar (detail)

| Expression = concept *( "+" concept ) [ ":" ws refinements ] |
| An expression supports combinations of one or more concepts optionally refined by a set of refinements. The meaning of the expression is a subtype of all the concepts constrained by the set of refinements. |
| Note that where there is a requirement for multiple separately qualified concepts to be present these are expressed in attribute groups within a refinement of a general concept such as "situation with explicit context". |
| concept = ws conceptId ws ["]" ws term ws "]" ws ]

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A concept is represented by a `conceptId` optionally followed by a `term` enclosed by a pair of `"|"` characters. Whitespace before or after the `conceptId` is ignored as is any whitespace between the initial `"|"` characters and the first non-whitespace character in the `term` or between the last non-whitespace character and before second `"|"` character.

### conceptId = scid

The `conceptId` must be a valid SNOMED CT identifier for a concept. The initial digit may not be zero. The smallest number of digits is six, and the maximum is 18.

### term = 1*nonwsnonpipe *( 1*SP 1*nonwsnonpipe )

The `term` must be the `term` from a SNOMED CT description that is associated with the concept identified by the preceding `concept identifier`. For example, the `term` could be the preferred `description`, or the preferred `description` associated with a particular translation. The `term` may include valid UTF-8 characters except for the pipe `"|"` character. The `term` begins with the first non-whitespace character following the starting `"|"` character and ends with the last non-whitespace character preceding the next `"|"` character.

### refinements = ( attributeSet *attributeGroup ) / 1*attributeGroup

A refinement contains all the grouped and ungrouped attributes that refine the meaning of the containing expression. The ungrouped attributes, if any, are all listed first, followed by all the grouped attributes.

### attributeGroup= " { " attributeSet " } " ws

An attribute group contains a collection of attributes that operate together as part of the refinement of the containing expression.

### attributeSet= attribute *( "," attribute )

An attribute set contains one or more `attribute name`-value pairs expressing refinements. They are separated by commas.

### attribute= attributeName "= " attributeValue

An `attribute name`-value pair expressing a single refinement of the containing expression.

### attributeName= ws attributeNameId ws [ " |" ws term ws "| " ws ]

The name (or relationship type) of an attribute to which a value is applied to refine the meaning of a containing expression. The `attribute name` is represented by an appropriate `conceptId` optionally followed by a `term` enclosed by a pair of `"|"` characters. Whitespace before or after the `conceptId` is ignored as is any whitespace between the initial `"|"` characters and the first non-whitespace character in the `term` or between the last non-whitespace character and before second `"|"` character.

---

7 The specification for term should be comparable with the specification for the Concepts.FullySpecifiedName and Descriptions. Term fields in the release table structure (as described in SNOMED Clinical Terms Technical Reference Guide, July 2008, IHTSDO). The non-pipe constraint adds greater stringency to the Compositional Grammar specification.
A concept or expression representing the value of a named attribute which refines the meaning of a containing expression. If an expression is used this must be enclosed in brackets.

The attribute name id must be the conceptId for a concept that is a subtype descendant of the SNOMED CT concept "attribute".

A n sctId is used for an attribute id or a concept id. The initial digit may not be zero. The smallest number of digits is six, and the maximum is 18.

Whitespace characters (space, tab, linefeed and carriage return) are ignored everywhere in the expression except:

1. Whitespace within a conceptId or attributeNameId is an error.
   Note: Whitespace before or after the last digit of a valid Identifier is ignored.

2. Whitespace within a term is treated as a significant character of the term.
   Note: Whitespace before the first or after the last non-whitespace character of a term is ignored

Non whitespace includes printable ASCII characters (these are also valid UTF8 characters encoded as one octet) and also includes all UTF8 characters encoded as 2-3- or 4-octet sequences. It excludes space (which is %x20) and the pipe character "|" (which is %x7C), and excludes CR, LF, HTAB and other ASCII control codes. SeeRFC 3629 (UTF-8, a transformation format of ISO 10646 authored by the Network Working Group).

The first character of a concept identifier is constrained to a digit other than zero.

Any digit 0 through 9

4.3.4.1.4 Examples of Grammar

The following examples build on each other and in complexity. They are primarily aimed at demonstrating the syntax of the expression grammar, although its meaning is also discussed in a number of places:

An expression may consist of a single concept, followed by a description associated with that concept. Which particular description to use is not mandated, but as a general rule, it may be preferable to use the preferred term in any particular dialect to achieve some level of consistency. However, such guidance is not strictly in the scope of this guide, and may be given elsewhere.
The syntax does not require a *description* to be associated with a particular *concept*, so the following is also a valid *expression*:

297186008

Two or more *concepts* may be combined to form a new *concept* by joining them with the "+" symbol. The resultant *expression* is the *child* of each of the *concepts* in the *expression*. The resultant *expression* below is an accident caused by a blizzard and also is a motorcycle accident.

217724009 | accident caused by blizzard | + 297186008 | motorcycle accident |

Although not stipulated by the syntax, note that two *concepts* joined in this way must be from the same *top level hierarchy*. The syntax does not mandate which *concepts* in the *expression* should have associated *descriptions* and which should not so it is valid, but not advisable, to mix and match. For example, the following syntax is valid:

217724009 + 297186008 | motorcycle accident |

The syntax allows spaces, tabs and carriage returns in most places. For example, the following examples have identical meaning to the one above:

217724009 + 297186008 | motorcycle accident |

+ 297186008

| motorcycle accident |

Using the "+" symbol is symmetrical and equivalent to starting with one of the *concepts* and adding an *is a | refinement*, with a *value set* to the other *concept*. For example, the following two *expressions* are equivalent to each other and to the preceding *expression*:

217724009 | accident caused by blizzard |

116680003 | is a | =297186008 | motorcycle accident |

297186008 | motorcycle accident |

116680003 | is a | =217724009 | accident caused by blizzard |

One or more *refinements* may be added to a *concept* to qualify it. This is done by putting the *concept* to be qualified before a colon and the qualifying *expression* after. The qualifying *expression* is of the form "attribute = value". The example below describes an operation to remove an ovary using a laser.

83152002 | oophorectomy |

260686004 | method | =257820006| laser excision - action |

*Refinements* may also be applied to a conjoined *concept*. For example, the following two *expressions* (building on a preceding example) are equivalent:

313056006 | epiphysis of ulna |

272741003 | laterality | =7771000 | left |

119189000 | ulna part | + 312845000 | epiphysis of upper limb |

272741003 | laterality | =7771000 | left |

Note that there are no brackets round "119189000 | ulna part | + 312845000|epiphysis of upper limb"in the above example.

Where more than one qualifying *expression* is required, these can be separated using a comma. The example below describes the removal of the right ovary using laser excision.

83152002 | oophorectomy |

260686004 | method | =257820006| laser excision - action |

363704007 | procedure site | =20837000 | structure of right ovary |

A further example, below, describes the removal of the left fallopian tube using diathermy excision:
Where a SNOMED CT concept comprises a number of other concepts or sub-expressions, it may be necessary to group qualifications applied to that concept in order to avoid ambiguity as to how they apply. An example of a SNOMED CT concept that comprises a number of other sub-expressions is:

116028008 | salpingo-oophorectomy |

This procedure comprises two sub-procedures: the excision of part of all of the ovarian structure; and the excision of part or all of the fallopian tube structure. We should note at this point that there is a subtle difference between a subsumptive relationship and a comprising relationship:

A motorcycle accident caused by low visibility is a motorcycle accident AND is an accident caused by a blizzard.

A salpingo-oophorectomy comprises a fallopian tube excision and an oophorectomy.

This is demonstrated by the SNOMED CT normal form for salpingo-oophorectomy, as shown below:

71388002 | procedure |:
{260686004 | method | =129304002 | excision - action |,
405813007 | procedure site - Direct | =15497006 | ovarian structure |}
{260686004 | method | =129304002 | excision - action |,
405813007 | procedure site - Direct | =31435000 | fallopian tube structure |}

Where it is necessary within a postcoordinated expression to unambiguously qualify individual components of a concept comprised of a number of other expressions (as in the above example), grouping may be used. The following example describes a salpingo-oophorectomy, with laser excision of right ovary and diathermy excision of left fallopian tube. Note that without the grouping, it would not be possible to tell on what structure the laser excision was used and on what structure the diathermy excision was used.

116028008 | salpingo-oophorectomy |:
{260686004 | method | =257820006 | laser excision - action |,
363704007 | procedure site | =20837000 | structure of right ovary |}
{260686004 | method | =261519002 | diathermy excision - action |,
363704007 | procedure site | =113293009 | structure of left fallopian tube |}

A number of grouped qualifiers may be thus used to refine a concept. Note there is no comma between adjacent groups (as there are between adjacent expressions). Also note, the syntax does not limit the number of qualifiers in a group or the number of groups within an expression.

It is also possible to nest expressions, one inside the other. Any legal expression may be wrapped in a pair of brackets, and included in another expression in the same way as a concept would be. For example, the following expression describes a fracture of the femur caused by a motorcycle accident in a blizzard:

71620000 | fracture of femur |:
42752001 | due to | (217724009 | accident caused by blizzard | +297186008 | motorcycle accident |)

In the example above, note the use of "( )" brackets, to identify a nested expression, as opposed to "{ }" brackets, used elsewhere, to identify groups.

The following examples show how complex expressions may be build up from simple ones, a layer at a time. This first expression describes a left hip:

24136001 | hip joint structure |:
272741003 | laterality | =7771000 | left |

This next uses the "left hip" expression to describe a procedure to replace it:

397956004 | prosthetic arthroplasty of the hip |:
Applying a further grouped refinement to the above describes a procedure to replace a left hip by inserting a prosthesis. Note that this example mixes an ungrouped qualification and a grouped qualification. Where this is done, all ungrouped qualifications should appear before the groups. Note also that there is no comma between the last qualification and the first group.

Finally, the above expression may be included within a contextual wrapper, to describe a procedure that has been performed on a patient to replace a left hip by inserting a prosthesis.

4.3.4.2 Expression in definition forms

An expression can be transformed to definition form and the representations applicable to this alternative form can then be applied. However, this approach is limited because several of the forms used to represent concept definitions do not support nesting.

4.3.4.3 Human-readable renderings

An expression may be rendered according to particular rules to generate human-readable representations.

Specific "simple" rules have been specified by NHS Connecting for Health in the UK. Alternative suggestions for more natural rendering have also been made to extend this initial outline proposal.

Advice on this topic may be added to future revisions of this guide.

4.3.5 Stated Relationships Guide

This part of the Guide provides information about the Stated relationship file and the Web Ontology Language (OWL) transformation.

4.3.5.1 Stated Relationships File

The Stated Relationships File contains the stated form of SNOMED CT. The stated form of a Concept is the Description Logic definition that is directly edited by authors or editors. It consists of the stated | is a | relationships plus the defining relationships that exist prior to running a classifier on the logic definitions. Therefore, the stated form of a Concept is represented by a collection of relationships: one or more | Is a | relationships and zero or more defining relationships.

The Stated Relationships File is in the same table format as the Relationship File, but the value of the characteristicTyped field is | Stated relationship (core metadata concept) |.

The stated form enables implementers to test a classifier for consistency, by comparing the results of classification with the distributed Relationship File, which is the inferred form.

Implementers should not use the Stated Relationships File unless they understand the implications of using this and provide software which makes Description Logic inferences from the stated form. The standard distribution form (the Relationships File) provides a inferred view which includes inferences derived from the stated form.
4.3.5.2 Description Logic (OWL or KRSS) Transform

The Description Logic Transform Script, written in the Perl language, performs a transform of the Stated Relationships into Web Ontology Language (OWL) format or KRSS format. There are two options for the syntax of the OWL output: RDF/XML, or OWL Functional Syntax. The RDF/XML is more verbose and results in a file approximately double the size of the Functional Syntax file.

4.3.5.2.1 Object Properties

SNOMED CT's attributes, the middle element of the concept-Relationship-concept triple, correspond to OWL Object Properties. The hierarchy under 410662002 | concept model attribute | contains all the attributes that have been approved for use as object properties. In addition, the subtype Relationships (i.e. | Is a | Relationships) between attributes in the | concept model attribute | hierarchy, as expressed in the stated relationship file, are used by the script to automatically generate the corresponding sub-property axioms in OWL. For example, | Procedure site - Direct | appears as a subtype of | PROCEDURE SITE | in the stated relationship file, and so the script automatically makes the OWL object property 'PROCEDURE SITE DIRECT' a sub-property of OWL object property 'PROCEDURE SITE'.

4.3.5.2.2 Relationship Grouping

When transforming Relationships to OWL or KRSS, all rows that have a RelationshipType that are allowed to be grouped, even if a particular row is ungrouped (i.e. even if the row has a RelationshipGroup value meaning ‘ungrouped’), must be nested under an existential restriction that represents the (potential) grouping. This existential restriction is labelled, with the OWL object property called ‘Role group (attribute)’. It is just another attribute, in the sense that it has a SNOMED CT identifier and is named in the distributed concept file (609096000 | Role group |). In KRSS syntax, the stated definition of myConceptId1 with a stated definition that has a row with the triplet consisting of myConceptId1, myRelationshipType, myConceptId2 would translate into:

```plaintext
(defprimconcept myConceptId1
  (and parentConceptId
    (some RoleGroupId
      (some myRelationshipType myConceptId2))))
```

Attributes that are never grouped:

All RelationshipTypes are allowed to be grouped except | IS A |, and the following four:

- 123005000 | PART OF |
- 272741003 | LATERALITY |
- 411116001 | HAS DOSE FORM |
- 127489000 | HAS ACTIVE INGREDIENT |

4.3.5.2.3 Right Identities

There has historically been limited use of right identities, also known as property chains, in SNOMED CT. The one property chain that is in the current release is | DIRECT SUBSTANCE | o | HAS ACTIVE INGREDIENT | -> | DIRECT SUBSTANCE |. The OWL transform properly represents this property chain in the OWL 2 EL Profile. It is not yet represented in the relationship file, or anywhere else in standard SNOMED CT distribution files. This is a recognised deficiency which has not yet been addressed partly because there is only one such declaration, and no inferences in standard release are affected by this single right identity declaration.

4.3.5.2.4 Running the Perl transform script

Run the script according to the pattern:

```plaintext
perl <scriptfilename> <arg0> <arg1>
```

where

- `<scriptfilename>` is the name of the file containing the transform script
- In the July 2014 release this Perl script file is named: `tls2_StatedRelationshipsToOwlKRSS_INT_20140731.pl`
- `<arg0>` can be KRSS, OWL, or OWLF
KRSS causes output to be formatted according to KRSS2 which is parsable by the OWL API 3.4.2, or by CEL or other classifiers.

OWL causes output to be formatted according to OWL XML/RDF.

OWLF causes output to be formatted according to the OWL functional syntax.

<arg1> is the directory containing the RF2 Snapshot subdirectories. If the current directory is RF2/Snapshot, then just use dot (".") to designate the current directory, as in the following example:

```
C:\> perl tls2_StatedRelationshipsToOwlKRSS_INT_20140731.pl OWLF
```

The default output file name is snomedct_[arg0].owl, so if arg0 is OWLF, the output file will be snomedct_owlf.owl, but this can be changed in the Perl script itself (line 178) or the file can be renamed after generating it.

Alternatively you can separately supply arguments for all the file names (with their directories if necessary):

```
perl <scriptfilename> <arg0> <arg1> <arg2> <arg3> <arg4> <arg5> <arg6>
```

- **<arg0>** can be KRSS, OWL, or OWLF
  - KRSS causes output to be formatted according to KRSS2 which is parsable by the OWL API 3.4.2, or by CEL or other classifiers
  - OWL causes output to be formatted according to OWL XML/RDF
  - OWLF causes output to be formatted according to the OWL functional syntax

- **<arg1>** is the directory path and name of the file containing the RF2 format *SNOMED CT Concept file* snapshot
  - In the July 2014 release this file is located in directory RF2Release/Snapshot/Terminology/ and is named: sct2_Concept_Snapshot_INT_20140731.txt

- **<arg2>** is the directory path and name of the file containing the RF2 format *SNOMED CT Description file* snapshot
  - In the July 2014 release this file is located in directory RF2Release/Snapshot/Terminology/ and is named: sct2_Description_Snapshot-en_INT_20140731.txt

- **<arg3>** is the directory path and name of the file containing the RF2 format *SNOMED CT Stated relationship file*
  - In the July 2014 release this file is located in directory RF2Release/Snapshot/Terminology/ and is named: sct2_StatedRelationship_Snapshot_INT_20140731.txt

- **<arg4>** is the directory path and name of the file containing the RF2 format Text Definitions Table snapshot
  - In the July 2014 release this file is located in directory RF2Release/Snapshot/Terminology/ and is named: sct2_TextDefinition_Snapshot-en_INT_20140731.txt

- **<arg5>** is the directory path and name of the file containing the RF2 Language Refset snapshot
  - In the July 2014 release this file is located in directory RF2Release/Snapshot/Refset/Language/ and is named: der2_cRefset_LanguageSnapshot-en_INT_20140731.txt

- **<arg6>** is the directory path and name of the output file. Any valid file name can be used.
  - for example: res_StatedOWLF_INT_20140731.owl

An example execution command on a Windows machine, from a command prompt at the directory RF2Release/Snapshot, to produce the *stated view* of *SNOMED CT* according to OWL Functional syntax, would then look like the following:

```
C:\> perl tls2_StatedRelationshipsToOwlKRSS_INT_20130731.pl OWLF
```

```
Terminology/sct2_Concept_Snapshot_INT_20140731.txt
Terminology/sct2_Description_Snapshot-en_INT_20140731.txt
Terminology/sct2_StatedRelationship_Snapshot_INT_20140731.txt
Terminology/sct2_TextDefinition_Snapshot-en_INT_20140731.txt
```

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4.3.5.2.5 Importing into an editor

Once the output file has been successfully created (e.g. res_StatedOWL_INT_20140731.owl), an ontology editor that uses the OWL API should be able to import the file, assuming that the editor can handle very large files and that it is configured to use large amounts of memory, and your system has adequate memory (see FAQ below). The current version of the transform script has been tested with Protege running the OWL API version 3.4.2 and the OWL 2 Profile is OWL 2 EL. The table below presents the metrics that result from the July 2014 release.

Table 22: Metrics to Validate Import of SNOMED OWL, July 2014 International Release (20140731)

<table>
<thead>
<tr>
<th>Protege Ontology Metrics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class count</td>
<td>299239</td>
</tr>
<tr>
<td>Object property count</td>
<td>62</td>
</tr>
<tr>
<td>DL expressivity</td>
<td>ALER</td>
</tr>
<tr>
<td>SubClassOf axioms count</td>
<td>229330</td>
</tr>
<tr>
<td>Equivalent class axioms count</td>
<td>69908</td>
</tr>
<tr>
<td>Sub object property axioms count</td>
<td>11</td>
</tr>
<tr>
<td>SubPropertyChainOf axioms count</td>
<td>1</td>
</tr>
<tr>
<td>Annotation Assertion axioms count</td>
<td>756457</td>
</tr>
</tbody>
</table>

4.3.5.2.6 SNOMED CT OWL Distribution FAQ

4.3.5.2.6.1 Access

1. Where do I obtain a copy of the OWL version of SNOMED CT?
   - You can currently generate an OWL version of SNOMED CT using the Perl script and 'stated view' file in the standard distribution of SNOMED CT.
   - The Perl script and Stated Relationships File are distributed in the main release in different directories. The script is located in a folder called ‘Resources/StatedRelationshipsToOwlKRSS/’ and the RF2 snapshot files for concepts, Descriptions and stated Relationships are located in a folder called ‘RF2Release/Snapshot/Terminology’. Prior to the January 2012 release, the transform was based on an RF1 format stated Relationships file - see documentation of prior releases for historical data and transform scripts.

2. What do you mean I need to 'generate' the OWL version of SNOMED CT?
   - The OWL version of SNOMED CT is currently not distributed with the core release. However you can generate a local OWL version of SNOMED CT by executing the Perl script mentioned above. The instructions for using the Perl script are included in the Stated Relationships Guide (part of the Technical Implementation Guide), and also as comments in the header of the file containing the Perl script, which can be viewed in your favourite text editor (e.g. Notepad, Wordpad, etc).

3. What do I need to generate the OWL version of SNOMED CT?
   - In order to generate the OWL version of SNOMED CT, you will need to have ‘Perl’ installed on your machine.
   - In addition to the Stated Relationships file and Perl script mentioned, you will also require the RF2 (Release Format 2) version of the concept file, description file, and language reference set. These files are named ‘sct2_Concept_Snapshot_INT_yyyymmdd.txt’, ‘sct2_Description_Snapshot-en_INT_yyyymmdd.txt’, and ‘der2_cRefset_LanguageSnapshot-en_INT_yyyymmdd.txt’ in the January 2012 International Release and subsequently. The first two are found in the ‘RF2Release/Snapshot/Terminology’ folder, and the third is found in the ‘RF2Release/Snapshot/Refset/Language’ folder of the International Release.

4. I get errors when I try to generate the OWL version using the Perl script. What can I do?
• Please check the following, before you report errors in the build process:
• Ensure you have Perl properly installed on your machine.
• Ensure that you are using versions of the Perl script, Stated Relationships, Concepts, and Descriptions all from the same release date and same Release Format (i.e. RF2). You will definitely get errors if you try to use a script designed for RF2 on RF1 format files, and vice versa. There is no guarantee of backwards compatibility of the script - i.e. a version released for use with July 2013 RF2 files may not work with prior release RF2 files.
• Errors may be reported on the IHTSDO Collaborative Space, under the Implementation SIG site (in the General Discussions Forum).

4.3.5.2.6.2 Licensing

1. What are the licence restrictions on the OWL version of SNOMED CT?
   • There is a single world-wide licence for SNOMED CT for all purposes, called the “affiliate licence”. The same licence applies to the OWL version of SNOMED CT. You can find it by following the highlighted link labelled “SNOMED CT Affiliate Licence Agreement” on the right hand side of the page at www.ihtsdo.org/join-us/use-snomed-ct-licenses

4.3.5.2.6.3 Importing and Visualisation

1. How do I load and visualise SNOMED CT in OWL format?
   • Though the KRSS or OWL files generated by the Perl script can be viewed in a text editor, in order to sensibly visualise the OWL release you require a tool like Protége 4 (http://protege.stanford.edu/). Please note that version 4 (or later) of Protége is required to load and visualise SNOMED CT.

2. Protége crashes (or becomes unresponsive) when I try to visualise the class hierarchy on my machine!
   • Protége is known to take some time to generate the class hierarchy for display. It might be worthwhile increasing the memory allocation of Protége before your start loading SNOMED CT. Please refer to the relevant Protége documentation for exact details on increasing maximum memory available to Protége.

3. Help, the hierarchies are rendered as concept IDs in Protége! How can I change this into fully specified names?
   • You need change the rendering options in Protége to render using ‘labels’. In order to do that in Protége 4, select ‘Render using annotation values’ from ‘Preferences/Renderer/Entity rendering’.

4.3.5.2.6.4 Classification

1. What DL reasoners are currently supported for classifying OWL version of SNOMED CT?
   • There are Protége 4.x plugins for several DL reasoners that can classify SNOMED CT provided the machine specifications listed below are met. These include Snorocket, ELK, and Fact++.

2. How long does it take to classify SNOMED CT in Protége 4.x?
   • That depends on the classifier and how fast your machine is. Both Snorocket and ELK are very fast, and complete in well under 30 seconds (actual clock time) on an adequately configured machine.

3. How do I use the DL Query Tab in Protége 4 to create postcoordinated expressions?
   a. We recommend looking at the Protege OWL Tutorial (http://www.co-ode.org/resources/tutorials/ProtegeOWLTutorial.pdf) for more information on using Protege 4.x to construct expressions. In the Protege world, postcoordinated expressions are referred to as DL expressions.
   b. In order to create postcoordinated expressions in the DL query tab, you are required to use the Manchester syntax for the expressions. In order to understand the Manchester syntax, you will need to read and work the examples in the Protege OWL tutorial.
4. What can I do once I have classified SNOMED CT in Protégé 4.x?

- That depends on what you intended to do with a classified version of SNOMED CT. Within Protege 4.x, you can do subsumption testing over arbitrary DL expressions using the 'DL query tab' among other things. This feature might be used to implement subsumption testing over postcoordinated expressions.

4.3.5.2.6.5 Machine specification

1. What are the minimum specifications of machines for viewing loading and viewing SNOMED CT in OWL?

- As a general rule, for reasonable performance, one would require a 64-bit machine, such as an Intel Core 2 Duo, with clock speed of 2GHz or more and 4GB of RAM to load the OWL version of SNOMED CT in Protégé.
- The actual memory requirements might actually be smaller depending on your machine. Users have successfully loaded SNOMED CT on a 32-bit Mac OS X machine with 2GB RAM, and on a 32-bit Linux (Ubuntu) machine with 3GB RAM. However, display and editing performance is usually considered unacceptably slow when using these minimal configurations.
- Loading and visualising the OWL version of SNOMED CT using alternate methods might have different machine specifications.

2. What are the minimum specifications for classifying SNOMED CT?

- It is believed that one would require a 64-bit machine with an Intel Core 2 Duo processor (or better) with 4GB of RAM to classify SNOMED CT using the classifiers bundled with Protégé 4. Users have successfully classified SNOMED CT on a 32-bit Mac OS X machine with 2GB RAM, and on a 32-bit Linux (Ubuntu) machine with 3GB of RAM.

4.3.5.2.6.6 Software

1. Can I bundle the OWL version of SNOMED CT in my open source software?

- SNOMED CT is licenced under the affiliate licence described above. SNOMED CT or any derivatives of SNOMED CT cannot be redistributed under any other licence (including any form of open source licence).

2. Am I allowed to make extensions or modification to the OWL release of SNOMED CT and include it in my software?

- SNOMED CT is licenced under the affiliate licence described above. SNOMED CT or any derivatives of SNOMED CT cannot be redistributed under any other licence (including any form of open source licence).

3. What API can I use to programmatically access the OWL version of SNOMED CT?

- Though there are many candidate APIs available, most DL reasoners bundled with Protégé 4.x use the Manchester OWL API (owlapi.sourceforge.net). There are examples online on how to load an ontology. It might also be possible to use the Jena API (jena.sourceforge.net) to load the RDF/XML version of the file.

4.3.6 Other Representational Forms

This section summarises some of the other forms in which SNOMED CT components and expressions may be represented. This includes some references to a selection of proprietary and standard representation which have been used or suggested for particular uses. Mention in this section is intended to be illustrative and does not represent endorsement. Additional suggestions that may be helpful to some implementers could be added in future.
4.3.6.1 Complete Concept Representations

Representation of the concept as a whole includes the definition of the concept but also includes additional properties of concepts and associated components such as descriptions and Reference Sets.

As a rule representations of complete SNOMED CT concepts will be specific to SNOMED CT. Some of these representations will be specified by SNOMED and others will be application specific designs building on the SNOMED CT specifications. If generic forms of representation are used then guidelines on how particular properties from SNOMED are represented are necessary.

4.3.6.1.1 SNOMED CT distribution files

The Release File Specifications (5) provide a form of representation for complete concepts (and other components).

The release files are designed efficient for large scale batch distribution and facilitate easy import into relational databases. They may need to be indexed and optimised to provide a practical implementable representation.

4.3.6.1.2 IHTSDO workbench internal format

The set of database table used by the IHTSDO Workbench to maintain SNOMED CT include a full representation of all types of SNOMED CT Components. The representation is closely aligned with SNOMED CT Release Format 2. However, additional data is stored to manage workflow and conflict resolution during the development process.

4.3.6.1.3 SNOMED CT Distribution XML

The XML distribution schema specified by SNOMED provides a form of representation for complete concepts (including associated components).

The XML distribution files can be used as an alternative to the SNOMED CT distribution files. However, they are particularly efficient for communication of individual concepts or sets of concept (e.g. for update change-sets).

4.3.6.1.4 Application internal

SNOMED CT enabled applications will usually have their own internal optimised representation of the SNOMED distribution information. This may simply be a relational database with a specified set of indices or it may be a significantly different form.

Examples of proprietary representation include the forms used internally by CliniClue (ClueData), Health Language, Apelon TDE and other implementations.

4.3.6.1.5 Various human-readable renderings

Concept information may be rendered in various ways to allow human visualisation and understanding. These forms may include plain text, mark-up and graphical trees diagramming relationships. All of these renderings can be regarded as representations of complete concepts or their definitions.

4.3.6.2 Concept Definition Representations

See also: Complete concept representations

4.3.6.2.1 KRSS

KRSS is a general form for representing logical descriptions.

Transforms have been developed internally for producing KRSS representations of SNOMED CT definitions (see Stated Relationships Guide).

4.3.6.2.2 OWL

The Web Ontology Language (OWL) is a web-technology based approach to representation of logical concept definitions.

Transforms have been developed internally for producing OWL representations of SNOMED CT definitions (see Stated Relationships Guide).
4.3.6.2.3 Representing Definitions as Expressions

A Concept definition can also be represented as an expression (see Representational Forms for Expressions). One or more of the supertype parent concepts are represented as focus concepts and other defining relationships are represented as refining attributes.

4.3.6.2.4 Various human-readable renderings

Concept definitions may be rendered in various ways to allow human visualisation and understanding. These forms may include plain text, mark-up and graphical trees diagramming relationships. All of these renderings can be regarded as representations of concept definitions.

4.3.7 Additional Reference Materials

4.3.7.1 Introduction

This section contains additional technical information that does not referenced by other part of this guide.

4.3.7.2 Unicode UTF-8 encoding

4.3.7.2.1 Introduction

UTF-8 is an efficient encoding of Unicode character - strings that recognises the fact that the majority of text-based communications are in ASCII. It therefore optimises the encoding of these characters.

Unicode is preferred to ASCII because it permits the inclusion of accents, scientific symbols and characters used in languages other than English. The UTF-8 format is a standard encoding that provides the most efficient means of encoding 16-bit Unicode characters in cases where the majority of characters are in the ASCII range. Both UTF-8 and the alternative UTF-16 encoding is supported by all widely used operating systems and major applications (and has been for more than 15 years).

SNOMED CT uses the UTF-8 representation of characters in terms and other text fields.

4.3.7.2.2 Character encoding

ASCII characters are encoded as a single byte.

- Greek, Hebrew, Arabic and most accented European characters are encoded as two bytes;
- All other characters are encoded as three bytes;
- The individual characters are encoded according to the following rules.

4.3.7.2.2.1 Single byte encoding

Characters in the range 'u+0000' to 'u+007f' are encoded as a single byte.

Table 23: UTF-8 Single Byte Encoding

<table>
<thead>
<tr>
<th>byte 0</th>
<th>bits 0-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

4.3.7.2.2.2 Two byte encoding

Characters in the range 'u+0080' to 'u+07ff' are encoded as two bytes.

Table 24: Two byte encoding

<table>
<thead>
<tr>
<th>byte 0</th>
<th>byte 1</th>
<th>bits 6-10</th>
<th>bits 0-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
4.3.7.2.3 Three byte encoding

Characters in the range 'u+0800' to 'u+ffff' are encoded as three bytes:

Table 25: UTF-8 Three Byte Encoding

<table>
<thead>
<tr>
<th>byte 0</th>
<th>byte 1</th>
<th>byte 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1 1</td>
<td>0</td>
<td>bits 12-15</td>
</tr>
</tbody>
</table>

4.3.7.2.3 Notes on encoding rules

The first bits of each byte indicate the role of the byte. A zero bit terminates this role information. Thus possible byte values are:

Table 26: UTF-8 Encoding Rules

<table>
<thead>
<tr>
<th>Bits</th>
<th>Byte value</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>0???? ?? ?</td>
<td>000-127</td>
<td>Single byte encoding of a character</td>
</tr>
<tr>
<td>10??? ?? ?</td>
<td>128-191</td>
<td>Continuation of a multi-byte encoding</td>
</tr>
<tr>
<td>110?? ?? ?</td>
<td>192-223</td>
<td>First byte of a two byte character encoding</td>
</tr>
<tr>
<td>1110? ?? ?</td>
<td>224-239</td>
<td>First byte of a three byte character encoding</td>
</tr>
<tr>
<td>1111? ?? ?</td>
<td>240-255</td>
<td>Invalid in UTF-8</td>
</tr>
</tbody>
</table>

4.3.7.2.4 Example encoding

Table 27: UTF-8 Encoding Example

<table>
<thead>
<tr>
<th>Character</th>
<th>S</th>
<th>C</th>
<th>T</th>
<th>®</th>
<th>Bytes</th>
<th>Unicode</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCS</td>
<td>0053</td>
<td>0043</td>
<td>0054</td>
<td>00AE</td>
<td>01010011</td>
<td>01000011</td>
</tr>
<tr>
<td>®</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3.7.3 Check-digit Computation

The SCTID (See Component features - Identifiers on page 42) includes a check-digit, which is generated using Verhoeff's dihedral check. This section explains the algorithm used and includes sample source code for generating and checking the check-digit in Java Script and Microsoft Visual Basic.

4.3.7.3.1 Verhoeff’s Dihedral Group D5 Check

The mathematical description of this technique may appear complex but in practice it can be reduced to a pair of two-dimensional arrays, a single dimensional inverse array and a simple computational procedure. These three arrays are shown in the following tables.

- The first array contains the result of “Dihedral D5” multiplication;
- The second array consists of 8 rows of which two are defined while the rest are derived by applying the following formula: \( F(i, j) = F(i - 1, F(1, j)) \);
- The third array consists of a single row containing the inverse of the Dihedral D5 array it identifies the location of all the zero values in the first array.
Table 28: Results of Dihedral D5 multiplication

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 29: The full array for Function F

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>7</td>
<td>9</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>9</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 30: The Inverse D5 array

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
The Identifier is checked by starting at the rightmost digit of the Identifier (the check-digit itself) and proceeding to the left processing each digit as follows:

- \( Check = \text{ArrayDihedralD5}(Check, \text{ArrayFunctionF}((Position \mod 8), Digit)) \)
  - \( Check \) = the running value of the check-sum (starts at zero and modified by each step).
  - \( Position \) = the position of the digit (counted from the right starting at zero).
  - \( Digit \) = the value of the digit.

The final value of \( Check \) should be zero. Otherwise the check has failed.

When calculating the check-digit the same process is applied with a minor variation:

- \( Position \) is the position that the digit will have when the check-digit has been appended.
- The final value of \( Check \) is applied to the Inverse D5 array to find the correct check-digit.

\[ \text{Check-digit} = \text{ArrayInverseD5}(Check). \]

4.3.7.3.2 Sample Java Script for computing Verhoeff’s Dihedral Check

The script is presented here as part of an HTML page.

```
<!DOCTYPE html SYSTEM "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
  <head>
    <title>SNOMED CT Identifier Check</title>
    <style>
      body { font-family: Arial, Helvetica, sans-serif }
    </style>
    <meta content="text/html; charset=iso-8859-1" http-equiv="Content-Type">
    <script type="text/javascript" language="JavaScript">
      var FnF = new Array();
      FnF[0] = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9];
      FnF[1] = [1, 5, 7, 6, 2, 8, 3, 0, 9, 4];
      for (var i = 2; i < 8; i++) {
        FnF[i] = [
          ,,,,, ,,, ,
        ];
        for (var j = 0; j < 10; j++)
          FnF[i][j] = FnF[i - 1][FnF[1][j]];
      }
      var Dihedral = new Array(
        [0, 1, 2, 3, 4, 5, 6, 7, 8, 9],
        [1, 2, 3, 4, 0, 6, 7, 8, 9, 5],
        [2, 3, 4, 0, 1, 7, 8, 9, 5, 6],
        [3, 4, 0, 1, 2, 8, 9, 5, 6, 7],
        [4, 0, 1, 2, 3, 9, 5, 6, 7, 8],
        [5, 9, 8, 7, 6, 0, 4, 3, 2, 1],
        [6, 5, 9, 8, 7, 1, 0, 4, 3, 2],
        [7, 6, 5, 9, 8, 2, 1, 0, 4, 3],
        [8, 7, 6, 5, 9, 3, 2, 1, 0, 4],
        [9, 8, 7, 6, 5, 4, 3, 2, 1, 0]);
      var InverseD5 = new Array(0, 4, 3, 2, 1, 5, 6, 7, 8, 9);
      function VerhoeffCheck() {
      }
    </script>
  </head>
  <body>
    <!-- Content of the page -->
  </body>
</html>
```
{
    var check = 0;
    var IdValue = document.form.numcd.value;
    document.getElementById("out").innerText = "";
    document.getElementById("out").setAttribute("style", "colour:red;");
    document.getElementById("component").innerText = "Invalid partition";
    document.getElementById("component").setAttribute("style", "colour:green;");
    document.getElementById("extnamespace").innerText = "No namespace";
    document.getElementById("extnamespace").setAttribute("style", "colour:red;");

    for ( var i=IdValue.length-1; i >=0; i-- )
        check = Dihedral[check][FnF[(IdValue.length-i-1) % 8][IdValue.charAt(i)]];
    if ( check != 0 ) { document.getElementById("out").innerText = "Check-digit ERROR"; }
    else if (IdValue.length < 6) {document.getElementById("out").innerText = "SCTID too short";}
    else if (IdValue.length > 18) {document.getElementById("out").innerText = "SCTID too long";}
    else {document.getElementById("out").innerText = "Check-digit OK";
        document.getElementById("out").setAttribute("style", "colour:green;" );
        switch (IdValue.substr(IdValue.length-3,2))
            {
                case "00":
                    document.getElementById("component").innerText = "Concept";
                    document.getElementById("extnamespace").innerText = "International";
                    break;

                case "01":
                    document.getElementById("component").innerText = "Description";
                    document.getElementById("extnamespace").innerText = "International";
                    break;

                case "02":
                    document.getElementById("component").innerText = "Relationship";
                    document.getElementById("extnamespace").innerText = "International";
                    break;

                case "03":
                    document.getElementById("component").innerText = "Subset (RF1)";
                    document.getElementById("extnamespace").innerText = "International";
                    break;

                case "04":
                    document.getElementById("component").innerText = "Cross Map Set (RF1)";
                    document.getElementById("extnamespace").innerText = "International";
                    break;

                case "05":
                    document.getElementById("component").innerText = "Cross Map Target (RF1)";
                    document.getElementById("extnamespace").innerText = "International";
                    break;

                case "10":
                    document.getElementById("component").innerText = "Concept";
                    document.getElementById("extnamespace").innerText = IdValue.substr(IdValue.length-10,7);
                    break;

                case "11":
                    document.getElementById("component").innerText = "Description";
                    document.getElementById("extnamespace").innerText = IdValue.substr(IdValue.length-10,7);
                    break;

                case "12":
                    document.getElementById("component").innerText = "Relationship";
                    document.getElementById("extnamespace").innerText = IdValue.substr(IdValue.length-10,7);
                    break;

                case "13":
                    document.getElementById("component").innerText = "Subset (RF1)";
                    document.getElementById("extnamespace").innerText = IdValue.substr(IdValue.length-10,7);
                    break;

                case "14":
                    document.getElementById("component").innerText = "Cross Map Set (RF1)";
                    document.getElementById("extnamespace").innerText = IdValue.substr(IdValue.length-10,7);
                    break;

                case "15":
                    document.getElementById("component").innerText = "Cross Map Target (RF1)";
                    document.getElementById("extnamespace").innerText = IdValue.substr(IdValue.length-10,7);
                    break;
            }
}
default:
    document.getElementById("component").setAttribute("style", " colour:red;";)
}
if (document.getElementById("extnamespace").innerText=='International')
{
document.getElementById("extnamespace").setAttribute("style", " colour:green;";)
}
else if (IdValue.length>10) {document.getElementById("extnamespace").setAttribute("style", "
 colour:green;";)}
else {document.getElementById("extnamespace").innerText="Invalid Namespace";}
}
}

function VerhoeffCompute( )
{
    var IdValue = document.form.num.value; var check = 0;
document.form.numcd.value= "";
for ( var i = IdValue.length-1; i >=0; i-- )
check = Dihedral[check][FnF[(IdValue.length-i) % 8][IdValue.charAt(i)]];
document.form.numcd.value = document.form.num.value + InverseD5[check];
VerhoeffCheck();
document.getElementById("out").innerText = "Computed check-digit";
}
</script>
</head>
<body>
<h1>SNOMED CT Identifier Check</h1>
<form action="" name="form">
<table border="1" width="441">
<tr>
<td width="212" height="25">
    Partial Identifier <br/>(without check-digit)&nbsp;
</td>
<td width="115" height="25">
    <input name="num" size="18"/>
</td>
<td width="92" height="25">
    <input onclick= "VerhoeffCompute()" type="button" value="Compute"/>
</td>
</tr>
<tr>
<td width="212" height="35">
    SNOMED CT Identifier
</td>
<td width="115" height="35">
    <input name="numcd" size="18"/>
</td>
<td width="92" height="35">
    <input onclick= "VerhoeffCheck()" type="button" value="Check"/>
</td>
</tr>
<tr>
<td width="212" height="23">
    Result of check&nbsp;
</td>
<td width="115" height="23" colspan="2" id="out">
    <tr>
        <td width="212" height="23">
            Component type
        </td>
        <td width="115" height="23" colspan="2" id="component">
        </td>
    </tr>
    <tr>
        <td width="212" height="23">
            Namespace
        </td>
        <td width="115" height="23" colspan="2" id="extnamespace">
        </td>
    </tr>
</td>
</tr>
</table>
</form>
</body>
This Verhoeff checking part of this code was based on a webpage at:

http://www.augustana.ab.ca/~mohrj/algorithms/checkdigit.html

4.3.7.3.3 Sample Visual Basic for computing Verhoeff's Dihedral Check

Option Explicit

Private Dihedral(9) As Variant
Private FnF(7) As Variant
Private InverseD5 As Variant

Public Function VerhoeffCheck(ByVal IdValue As String) As Boolean
'Check the supplied value and return true or false
Dim tCheck As Integer, i As Integer
VerhoeffArrayInit
For i = Len(IdValue) To 1 Step -1
    tCheck = Dihedral(tCheck)(FnF((Len(IdValue) - i) Mod 8)(Val(Mid(IdValue, i, 1))))
Next
VerhoeffCheck = tCheck = 0
End Function

Public Function VerhoeffCompute(ByVal IdValue As String) As String
'Compute the check digit and return the identifier complete with check-digit
Dim tCheck As Integer, i As Integer
VerhoeffArrayInit
For i = Len(IdValue) To 1 Step -1
    tCheck = Dihedral(tCheck)(FnF((Len(IdValue) - i + 1) Mod 8)(Val(Mid(IdValue, i, 1))))
Next
VerhoeffCompute = IdValue & InverseD5(tCheck)
End Function

Private Sub VerhoeffArrayInit()
'Create the arrays required
Dim i As Integer, j As Integer
'if already created exit here
If VarType(InverseD5) >= vbArray Then Exit Sub
'create the DihedralD5 array
Dihedral(0) = Array(0, 1, 2, 3, 4, 5, 6, 7, 8, 9)
Dihedral(1) = Array(1, 2, 3, 4, 0, 6, 7, 8, 9, 5)
Dihedral(2) = Array(2, 3, 4, 0, 1, 7, 8, 9, 5, 6)
Dihedral(3) = Array(3, 4, 0, 1, 2, 8, 9, 5, 6, 7)
Dihedral(4) = Array(4, 0, 1, 2, 3, 9, 5, 6, 7, 8)
Dihedral(5) = Array(5, 9, 8, 7, 6, 0, 4, 3, 2, 1)
Dihedral(6) = Array(6, 5, 9, 8, 7, 1, 0, 4, 3, 2)
Dihedral(7) = Array(7, 6, 5, 9, 8, 2, 1, 0, 4, 3)
Dihedral(8) = Array(8, 7, 6, 5, 9, 3, 2, 1, 0, 4)
Dihedral(9) = Array(9, 8, 7, 6, 5, 4, 3, 2, 1, 0)
'create the FunctionF array
FnF(0) = Array(0, 1, 2, 3, 4, 5, 6, 7, 8, 9)
FnF(1) = Array(1, 5, 7, 6, 2, 8, 3, 0, 9, 4)
'compute the rest of the FunctionF array
For i = 2 To 7
    FnF(i) = Array(0, 0, 0, 0, 0, 0, 0, 0, 0, 0)
    For j = 0 To 9
        FnF(i)(j) = FnF(i - 1)(FnF(1)(j))
    Next
Next
'Create the InverseD5 array
InverseD5 = Array("0", "4", "3", "2", "1", "5", "6", "7", "8", "9")
End Sub

4.3.7.3.4 Reasons for using a check-digit

Although a user should rarely type the SCTID, experience suggests that from time to time this will happen. A user may also copy and paste an SCTID. There is a significant risk of errors in these processes and inclusion of a check-digit is intended to reduce the risk of such errors passing undetected. The choice of check-digit algorithm has been made to maximise the detection of common typographical errors. These have been analysed by a paper by J. Verhoeff ("Error Detecting Decimal Codes", Mathematical Centre Tract 29, The Mathematical Centre, Amsterdam, 1969) and subsequently cited in Wagner and Putter, ("Error Detecting Decimal Digits", CACM, Vol 32, No. 1, January 1989). These papers give a detailed categorisation of the sorts of errors humans make in dealing with decimal numbers, based on a study of 12000 errors:

- single errors: a becomes b (60% to 95% of all errors).
- omitting or adding a digit (10% to 20%).
- adjacent transpositions: ab becomes ba (10% to 20%).
- twin errors: aa becomes bb (0.5% to 1.5%).
- jump transpositions: acb becomes bca (0.5% to 1.5%).
- jump twin errors: aca becomes bcb (below 1%).
- phonetic errors: a0 becomes 1a - similar pronunciation e.g. thirty or thirteen (0.5% to 1.5%).

In the explanations above, a is not equal to b, but c can be any decimal digit.

4.3.7.3.4.1 A brief comparison of check-digit effectiveness

4.3.7.3.4.1.1 The IBM Check

The check-sums used for credit cards (the IBM check) picks up the most common errors but miss some adjacent transpositions and many jump transpositions. Assuming the pattern of errors described above, on average it will miss between 4% and 5% of expected errors.

4.3.7.3.4.1.2 The ISBN Check (Modulus 11)

The ISBN modulus 11 (used for UK NHS number) picks up more errors than the IBM checksum. Leaving 2% to 3% of errors undetected. However, it generates a check-sum value of 0 to 10 and thus cannot be represented as a single check-digit in about 9% of cases. The ISBN convention is to use "X" to represent the check-digit value 10 but this is incompatible with an integer representation. The UK NHS number uses this check-sum but regards and number generating a check-sum of 10 as an invalid Identifier. This approach could be applied to the SCTID but this would render 9% of possible values unusable in each partition and namespace. This would prevent a simple sequence of values from being allocated as the "item Identifier" within each namespace. More significantly the unusable item Identifiers would differ in each namespace or partition and this would prevent simple transpositions of item Identifiers between partitions and namespaces. Partitions could be a useful way of distinguishing developmental and released components and revising the partition and recalculating the check-digit would then be an elegant way to activate these components for a distribution version. It seems unwise to prevent future development and maintenance by using a check-sum that will prevent this.
4.3.7.3.4.1.3 Verhoeff's Check

Verhoeff's check catches all single errors, all adjacent transpositions, over 95% of twin errors, over 94% of jump transpositions and jump twin errors, and most phonetic errors. Therefore, like modulus 11, the Verhoeff check reduces the undetected error rate to 2% or 3%. Unlike modulus 11, it does this using a single decimal check-digit and without limiting the range of valid numbers.

The majority of the undetected errors with both modulus 11 and Verhoeff result from additions or omissions of digits. Any check-digit methods is likely to miss 10% of such errors and since these comprise 10% to 20%. The Verhoeff scheme also misses four jump twin errors involving digits with a difference of 5 (i.e. 050 vs. 505, 161 vs. 616, 272 vs. 727, and 494 vs. 949).

4.3.7.4 Search Support Tables

4.3.7.4.1 Overview

Effective implementation of SNOMED CT depends on the ease and speed with which users can locate the terms and Concepts that they wish to use. An essential contribution to meeting this requirement is the ability to perform rapid and flexible text searches.

A set of word search tables (indexes) are included in the Developer Toolkit. These tables are designed to facilitate development of effective search facilities while reducing duplication of effort. However, neither these tables, nor indices derived from them, are sufficient to meet the full range of search requirements. Meeting the needs of different users for appropriate methods for locating particular Concepts is an area in which competitive development is expected and welcomed. Developers may choose to use some or all of the word search tables distributed with SNOMED CT or may develop their own solutions independent of these tables.

The intention of the word search tables is to identify candidate matches among the Descriptions (or Concepts) of SNOMED CT. An application or coding engine will apply further filtering to these candidate matches to identify the matches to be selected or displayed. A balance must be made between specificity and completeness of a search. The keyword algorithm is intended to maximise the likelihood that the required Concept will be included in the candidate matches rather than to achieve precision.

Applications may filter candidate matches using techniques that are many and varied. Some may take account of non-textual characteristics (e.g. Reference Sets, subtype Relationships or Relationships) while others use more complex textual techniques (e.g. word order dependence, case dependence, complete phrase matching, regular-expression matching, Soundex). These extended text search techniques are beyond the scope of the keyword generation algorithm.

The algorithm for keyword generation is only applicable for English and other western European languages. It is not intended to apply to Russian, Greek, Slavic or to any non-European languages.

Please refer to the Technical Implementation Guide for additional search implementation guidance.
4.3.7.4.3 Word Search Tables - Summary

The following five tables are included in the Developer Toolkit of SNOMED CT. These tables are derived from the SNOMED CT Descriptions Table. The LanguageCode of the Description file is used to choose only descriptions for a language.

Table 31: Summary of Word Search Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded Words Table</td>
<td>Each row in this table is a word excluded from the list of possible keywords and dualkeys. Words are excluded if they are frequently used and are so limited in semantic specificity that they impair rather than enhance searches.</td>
</tr>
<tr>
<td>DescWordKey Table</td>
<td>Each row in this table is a word followed by a reference to a Description in which this word appears.</td>
</tr>
<tr>
<td>ConcWordKey Table</td>
<td>Each row in this table is a word followed by a reference to a Concept. A Concept is referenced if the word appears anywhere in the combination of the Fully Specified Name with the current valid Preferred Term and Synonyms.</td>
</tr>
</tbody>
</table>
Each row in this table is a six-character string representing the first three letters of a pair of words followed by a reference to a Description in which these two words appear.

Each row in this table is a six-character string representing the first three letters of a pair of words followed by a reference to a Concept. A Concept is referenced if both words appear anywhere in the combination of the Fully Specified Name with the current valid Preferred Term and Synonyms.

All keywords are regarded as case independent and are presented in the word search tables in upper case. Case dependent searching can be applied by appropriately filtering the candidate matches.

4.3.7.4.4 Word Equivalents

The Word Equivalent Table is included in the Developer Toolkit of SNOMED CT. It supports enhanced searches that take into account semantically similar words such as KIDNEY and RENAL. It also provides commonly used abbreviations. This table can be used by implementers to offer additional search capability in applications without greatly increasing the volume of synonyms. It is not intended as a comprehensive dictionary of words. Many searches can be completed without using this table; like the other word search tables, it is completely optional and can be used as an example of a capability that may be customised and extended by SNOMED CT implementers.

4.3.7.4.4.1 Word Equivalents Tables - Summary

Table 32: Word Equivalents Table

<table>
<thead>
<tr>
<th>Key Fields</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WordBlockNumber</strong></td>
<td>A 32-bit integer shared by a set of equivalent words or phrases. The WordBlockNumber links together several rows that have an identical or similar meaning.</td>
</tr>
<tr>
<td><strong>WordText</strong></td>
<td>A word, phrase, acronym or abbreviation that is equivalent to the WordText of other rows that share the same WordBlockId.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Fields</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WordType</strong></td>
<td>An integer indicating the type of equivalence</td>
</tr>
<tr>
<td><strong>WordRole</strong></td>
<td>An integer indicating the usual role of this word. This should be considered if attempting to find a postcoordinated combination of Concepts that matches a phrase.</td>
</tr>
</tbody>
</table>
Chapter

5

5 Release File Specifications

This part of the guide specifies the formats in which SNOMED CT is provided to licensees (IHTSDO affiliates).

Note: For SNOMED CT licensing information and details about the availability of release files contact either the IHTSDO or the IHTSDO Member in your country. Contact details are available on the IHTSDO web site: www.ihtsdo.org.

5.1 Release File Formats

Currently, during a transitional period, there are two distinct Release Formats for SNOMED CT:

• Release Format 2 (RF2): The new standard distribution format for SNOMED CT. This was developed in response to extensive feedback on its predecessor and will replace RF1 during 2012.

• Release Format 1 (RF1): The specification in which SNOMED CT has been provided since its first release in 2002. This format will be phased out, but support of applications that require RF1 format files will be available using a conversion application developed and supplied by the IHTSDO.

The key enhancements in RF2 are:

• More robust and consistent version representation;

• Reference sets, provides a more easily extensible and maintainable replacement for RF1 representations of subsets and maps;

• Use of an added hierarchy to represent metadata about the structure of SNOMED CT itself.

Both Release Formats represent:

• The components of SNOMED CT:
  • Concepts
  • Descriptions
  • Relationships

• Additional derivatives that provide standard representations of:
  • Subsets of concepts or descriptions;
  • Value sets consisting of concepts and/or expressions;
  • Language and dialect preferences;
  • Alternative hierarchies;
  • Maps to other codes and classifications.

Both Release Formats are provided in:

• Tab-delimited text files;

• Represent character content in accordance with the Unicode UTF-8 specification;

• Use SNOMED CT Identifiers as the permanent Identifier of released core components;

• Support extensions to the International Release using namespaces allocated to licensees to denote the provenance of added components and to ensure Identifier uniqueness.
5.2 SNOMED CT Editions, Extensions, Releases and Modules

SNOMED CT is delivered as sets of files containing terminology components and derivatives. The format, content and names of the files delivered conform to SNOMED CT specification and guidelines published by the IHTSDO.

- Components represent the content on the terminology.
  - The standard SNOMED CT representation for content is as three interrelated files. The Concept file contains unique identifiers for clinical ideas, the Description file links human readable terms with identified concepts and the Relationship file represents associations between identified concepts.

- Derivatives facilitate the effective use of the terminology.
  - The standard SNOMED CT representation for derivatives is a consistent but flexible file format, known as the reference set format. Reference sets can be used for a wide range of purposes including subsets, language preferences, ordered lists, hierarchies, annotations and mapping to or from other terminologies, classifications and code systems.

IHTSDO maintains and delivers shared content and derivatives that provide the foundation of the SNOMED CT. This is known as the SNOMED CT International Edition.

IHTSDO also authorizes Members and Affiliates to maintain and deliver additional components and derivatives known as SNOMED CT Extensions.

- Any organization maintaining an Extension needs to have a namespace identifier allocated to them by the IHTSDO. Every component created must be allocated a new permanent SNOMED CT identifier which is in the originating organization’s namespace allocated. The namespace identifier of the originating organization forms part of every component identifier allocated.

IHTSDO Members may maintain and deliver additional terminology components and derivatives that adapt the terminology to meet specific national requirements (National Extension).

**Examples:**

A National Extension may include:

1. translation into the national language or adaption to a national dialect;
2. additional content to support national policy objectives, a national drug dictionary or other specific requirements;
3. derivatives that configure use of SNOMED CT content by specifying subsets of content to be used for particular purposes;
4. derivatives that map other code systems used in that country to or from SNOMED CT.

IHTSDO Affiliates may also maintain and deliver additional terminology components and derivatives that adapt the terminology to meet the needs of a particular organization, customer or software solution (Affiliate Extension).

**Examples:** An Affiliate Extension may include:

1. additional content enable a health provider organization or clinical specialty group to address its priority use cases;
2. derivatives that configure use of SNOMED CT in ways that reflect the needs of a health provider organization or specialty;
3. derivatives that configure the way SNOMED CT is used or presented to different customers using a particular software applications;
4. derivatives that map local or proprietary code systems to or from SNOMED CT.

The SNOMED CT International Edition can be used without any Extensions. However, a SNOMED CT Extension cannot be used on its own because all Extensions are dependent on the International Edition and some Extensions are also dependent on other Extensions. Therefore, for each Extension there is a
corresponding Edition that includes the Extension, the International Edition and any other Extensions on which it depends.

Examples:


2. Anyville Hospital in Healthitia is an IHTSDO Affiliate. It produces its a local Anyville Extension for use in the hospital and this Extension also depends upon the Healthitia National Extension. Therefore, the Anyville Edition consists of the International Edition, the Healthitia National Extension and the Anyville Extension;

3. AcmeGest an international provider of antenatal care systems is an IHTSDO Affiliate and uses the AcmeGest Extension to support some of its specialist functionality. This Extension only depends on the International Edition, therefore the AcmeGest Edition consist of the International Edition and the AcmeGest Extension.

4. The obstetric department of Anyville Hospital in Healthitia uses the AcmeGest system, so it requires the AcmeGest Extension as well as the Anyville Edition. The AcmeGest Extension has a dependency on the International Edition but this should only be resolved once.

For use in particular countries or institutions there may be advantages in distribution a complete Edition. However, as the last of example above illustrates, different Editions may share a common dependency on the International Edition. All organizations that maintain Extensions should make their Extension available as a separate set of files, even if they also provide a pre-merged Edition. This allow validation of the constituent parts of the Edition and also supports merges to produce bespoke Editions that combine several Extensions.

The IHTSDO provides regular updates of the SNOMED CT International Edition. Similarly, Members and Affiliates that maintain Extensions will from time to time release updated versions of their Extensions. Therefore, the SNOMED CT release file specifications define three different release file types:

- Full Release: containing the complete history of every component
- Snapshot Release: containing the current state of every component
- Delta Release (containing only the additions and changes since the previous release)

The International Edition is provided in all three release types. However, as the Snapshot and the Delta can be generated from the Full, the specification only requires that organizations that maintain Extensions provide a Full Release of their Extension.

5.3 Release Format 2 - Introduction

This section describes the release file structure of SNOMED CT. This file structure is referred to as Release Format 2 (RF2) to distinguish it from the previous Release Format (RF1) in which SNOMED CT was distributed between its first release in 2002 and 2012.

The Release Format 2 specification is divided into two parts. The RF2 Core Component Guide is concerned with the representation of the Concepts, Descriptions and Relationships that contain the primary content of SNOMED CT. The RF2 - Reference Sets Guide specifies the common extensible pattern that is used
to add additional information related to the core components. It also describes the ways in which this pattern is used to represent essential functionality (such as language specificity, historical status changes and associations) and optional additional functionality (including subsets, mapping and alternative navigation hierarchies).

In 2012 RF2 became the primary Release Format for SNOMED CT. Implementers requiring data in the RF1 format during a transitional period are initially being supported by use of conversion application developed by the IHTSDO which generates RF1 from RF2 files. It is important to note the RF2 features are not supported by the converted RF1 files and, eventually RF1 support will be withdrawn.

5.4 SNOMED CT - File Naming Conventions

The file naming convention specified in this section applies to all IHTSDO release files starting with the January 2010 International release.

The specification provides the following benefits:

• A consistent naming convention across the International edition and each National edition.
• Predictable file naming, providing a stable structure for naming over time between releases.
• A standard way to identify the source country and namespace by which a release file is owned.
• A consistent versioning mechanism.
• An easy human readable way to identify the content of a file, at a summary level.
• A mechanism for identifying the type of information stored in a release file (e.g. documentation, tooling, etc.).
• Guidance on file naming for release files in non-English extensions.
• Assurance that names will be unique across the International release and releases from individual National release centres and across separate releases from each centre over time.
• An upgrade path, to enable use of the same naming convention with the new release format (RF2), while enabling easy identification of whether a file is in RF1 or RF2 format, and avoiding naming clashes.

Quality Assurance checks, to ensure that this naming convention is enforced, will be performed as part of the International release process. It is expected that equivalent checks will be performed as part of each National Release Centre’s release process.

Note: Prior to January 2010 other naming strategies were used. Implementers who need to review earlier releases should consult the documentation that accompanied the release that they need to review.

5.4.1 File Naming Convention - Overview

5.4.1.1 General File Naming Pattern

The basic pattern for SNOMED CT release file names consists of five elements, each separated by an underscore (“_”) and followed by a full stop (“.”) and a file extension:

<FileType>_<ContentType>_<ContentSubType>_<Country|Namespace>_<VersionDate>.<Extension>

Each element in the above structure is described in more detail in subsequent sections.

5.4.1.2 General Naming Rules

The following rules apply generally to all elements of the file name:

• All elements are mandatory and may not have a null value;
• Elements of the file name may only contain alphanumeric characters, with the exception of hyphens (“-”) used in connection with language codes (see detail for the ContentSubType element below);
• All text should be in US English, except as explicitly allowed below;
• Abbreviations should not be used, except for specified codes or tags;
• The maximum length of a file name (including separators and extension) is 128 characters.
5.4.1.3 Rules for "Readme" Files
Readme files distributed as part of a SNOMED CT release have their own specific naming convention, as shown below:

Language is the language code for the language of the Readme file, as specified below for the ContentSubType element, and the VersionDate corresponds to the version date of the release.

5.4.2 FileType element

5.4.2.1 Description
The FileType element of the filename designates the type and intended use of the release file. It consists of a 3-5 letter code and must be lowercase.

5.4.2.2 Rules
Allowable FileType codes are shown in the table below:

Table 33: Allowable File Type Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>File Type Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;sct&quot; + &lt;format tag&gt;</td>
<td>Terminology Data File</td>
</tr>
<tr>
<td>&quot;der&quot; + &lt;format tag&gt;</td>
<td>Derivative Work Data File</td>
</tr>
<tr>
<td>&quot;res&quot; (+ &lt;format tag&gt;)</td>
<td>Implementation Resource Data File</td>
</tr>
<tr>
<td>&quot;tls&quot; (+&lt;format tag&gt;)</td>
<td>Implementation Resource Tool</td>
</tr>
<tr>
<td>&quot;doc&quot; (+&lt;format tag&gt;)</td>
<td>Documentation</td>
</tr>
<tr>
<td>&quot;z&quot; + Code</td>
<td>Archival/Unsupported File (e.g. zsct)</td>
</tr>
<tr>
<td>&quot;x&quot; + Code</td>
<td>Test/Beta Release File (e.g. xder)</td>
</tr>
</tbody>
</table>

The allowable file types are described in more detail below:

- **Terminology Data File ("sct")** - the set of data files that make up the SNOMED CT terminology. These are:
  - Concepts file
  - Descriptions file
  - Relationship File
  - Stated Relationships File
  - Identifier file (currently empty)

- **Derivative Work Data File ("der")** - data files that make up a SNOMED CT "derivative work" (a product for use in conjunction with SNOMED CT that cannot be effectively used without the terminology - such as subsets or maps). Examples of the files within this group include:
  - Reference Set Files.

- **Implementation Resource Data File ("res")** - data files intended to support developers with the implementation of SNOMED CT, but that are not necessarily useful to end-users. Examples from the current International Release include:
  - Implementation Resource Tool ("tls") - software tools or other files that do not contain original SNOMED CT content (i.e. that is not also held elsewhere in the release), but can be of use to...
implementers. If such files cannot comply with this naming convention (for example, if some other standard applies), then those files should be distributed as part of a ZIP file archive that does conform to this file naming convention.

- **Documentation**("doc") - documents defining SNOMED CT standards, policies and guidelines, as well as documentation for files or products included in a SNOMED CT release. Most, but not all, files in this group are released in a PDF format.

- **Archival/Unsupported File**("zsct", "zder", "zres", "ztls") - files that are not currently supported or updated, but may be of some use to implementers. These files should only be used with caution and after appropriate review and validation. The letter "z" is inserted in front of the usual FileType code for these files (i.e. "z" + "sct", "der", "res" or "tls"). Examples from the current International Release include:
  - SNOMED 3.5 to SNOMED RT bridge file;
  - SNOMED 2 to SNOMED RT bridge file.

- **Test/Beta Release File**("xsct", "xder", "xres", "xtls") - files distributed as part of a test/beta release, or as a "technology preview". These files should only be used for review and evaluation purposes. The letter "x" is inserted in front of the usual FileType code for these files (i.e. "x" + "sct", "der", "res" or "tls").

### 5.4.2.3 Format Tags

A Release Format tag must be appended at the end of the three-letter FileType code if the file named is dependent on a particular Release Format specification. The allowable Release Format tags are:

- For files that are part of the current Release Format (RF2), or applicable only to the RF2 Release Format, the number "2" is appended to the FileType code (e.g. "sct2", "der2", "res2").
- For files that are part of the now obsolete RF1 Release Format, or applicable only to that Release Format, the number "1" is appended to the FileType code (e.g. "sct1", "der1", "tls1").
- If the file is not specific to either Release Format, the three-letter FileType code should be used without a Release Format tag (e.g. "res", "tls" or "doc").
- The FileType code for all terminology and Derivative Work data files ("sct" or "der") must include a Release Format tag ("1" or "2"). For other file types, the Release Format tag is optional.

### 5.4.3 ContentType element

#### 5.4.3.1 Description

The ContentType element of the filename describes the content and purpose of the file. It consists of 2-48 alphanumeric characters in camel case.

#### 5.4.3.2 Rules

The content of this element depends on the first element (FileType) of the filename, as described below:

Possible values for the Release Format 2 are:

- Concept
- Description
- Relationship
- StatedRelationship
- Identifier
- Refset

For Data files where the ContentType element is "Refset", the ContentType element will also describe the format and content of the reference set member file. Each file of ContentType "Refset" will hold zero or more additional columns, each having one of the following types:

- Component
- String
Integer

Lower case "c", "s" and "i" will be used as abbreviations (for component, String and Integer respectively) to describe the format of the additional columns that will be appended to the end of each row in the Refset file. These abbreviations will prefix the ContentType element, as shown in the examples below:

- **cRefset** - a Refset file with one additional column, holding component values;
- **ssRefset** - a Refset file with two additional columns, both holding String values;
- **ciRefset** - a Refset file also with two additional columns, the first holding component values and the second holding integer values;
- **For Implementation Resource Tools ("tls")** - the value of the ContentType element may be determined on a case-by-case basis but, in conjunction with the ContentSubType element, should be adequate to identify the content and purpose of the file;
- **For Documentation ("doc")** - the title of the document, which may be abridged but should not be abbreviated, should be used as the value for the ContentType element;
- **For Archival & Test/Beta Files ("z"+ code or "x"+ code)** - the value of the ContentType element should be determined according to the rules for a normal file of the same type ("sct", "der", "res" or "tls").

### 5.4.4 ContentSubType element

#### 5.4.4.1 Description

The ContentSubType element of the filename provides additional information to describe the content and purpose of the file, including the language / dialect, where appropriate. Its format is 2-48 alphanumeric characters in camel case (except for the capitalisation rules specified below for language code). Hyphen ("-") is a permitted character in conjunction with a language code, as described below.

#### 5.4.4.2 Rules

The content of this element depends on the first element type (FileType), and these rules are described in more detail below:

- **Data Files ("sct", "der" or "res")** - as a result of RF2's state-valid history tracking capability, it is possible to perform a number of different releases of SNOMED CT content in the RF2 format:
  - A "Full" release of each file containing every version of every component ever released.
  - A "Snapshot" release, containing only the most recent version of every component ever released (both active and inactive components).
  - A "Delta" release, containing only component versions created since the last release. Each component version represents a new component or a change in an existing component.

Each RF2 ContentSubType element must be postfixed with a Release Type flag with a value of: "Full", "Snapshot" or "Delta". This flag should always appear at the end of the ContentSubType element, unless ContentSubType includes a language code (see below). If a language code is present in the ContentSubType element, the Release Type flag will appear immediately before the language code.

- **Implementation Resource Tool ("tls")** - the value of this element may be determined on a case-by-case basis but, in conjunction with the ContentType element, should be adequate to identify the content and purpose of the file. If appropriate, the element may contain a status tag with one of the values described below under Documentation.

- **Documentation ("doc")** - the element should contain at least two components: a status tag and a language code (see above). Additional components may be added to this element if necessary to fully identify the document. Possible values for the document status tag are:
  - "Current" - indicates that the document is up-to-date and complete for the current release of SNOMED CT, as indicated by the VersionDate element;
  - "Draft" - indicates that the document is a draft version; it may be incomplete and has not been approved in a final version;
  - "Review" - indicates that the document has been released for review and comments from SNOMED CT users and other stakeholders.
• Archival & Test/Beta File ("z"+ code or "x"+ code) - the value of the element should be determined according to the rules for a normal file of the same type ("sct", "der", "res" or "tls").

5.4.4.3 Language Usage

For files released as part of a National or local release, and which do not appear in the SNOOMED CT International Release, the value of the ContentSubType element may be given in a language other than English, with the following limitation:

• Any of the four sets of defined values for the ContentSubType element that are present in the file name may not be translated, but must appear as specified herein. These are: language code, Release Type flags ("Full", "Snapshot", "Delta"), placeholders ("Core", "National", "Local"), and status tags ("Current", "Draft", "Review").

5.4.4.4 Language Codes

Where it is necessary to specify the language of a file, a language code must be included in the ContentSubType element. A language code is a string identifying the language and, if appropriate, the dialect of a file, and consists of a code and optionally a sub-code. If a sub-code is present it is separated from the code by a hyphen ("- ").

The code is the two-character ISO 639-1 language code. ISO 639 is the International Standard for "Codes for the representation of names of languages". The sub code is a string of upper-case letters that represent the dialect. This deliberately mirrors the W3C approach and will either be:

• If the dialect is general to an entire country, the two-letter ISO 3166 country code is used. ISO 3166 is the International Standard for "Codes for the representation of names of countries".
• If dialects are used that are less common or not country or language linked, the IANA approach is used; this code consists of a string of more than two letters. IANA is the Internet Assigned Numbers Authority.


If the ContentSubType includes more than one component (e.g. document status and a language code), the language code must be the last component in the ContentSubType element and should be preceded by a hyphen ("- ") placed before the language code.

5.4.5 Country|Namespace element

5.4.5.1 Description

The Country | Namespace element of the filename helps to identify the organisation responsible for developing and maintaining the file. Its format is 2-10 alphanumeric characters consisting of 0, 2 or 3 upper-case letters followed by 0 or 7 digits.

5.4.5.2 Rules

The following rules apply to the content of this element:

• Letters, if present, are either the ISO -3166 2-character country code for an IHTSDO Member country or "INT" for files that are part of the IHTSDO's International Release of SNOMED CT;
• Digits, if present, are a SNOMED CT Namespace Identifier.

Valid combinations are:

• 2 characters only - the file is part of a Member National Release, but not part of a specific Namespace - this combination is not valid for Data Files ("sct", "der", or "res");
• 3 characters only ("INT") - the file is part of the IHTSDO International Release and belongs to the International Namespace;
• 2 characters and 7 digits - the file is part of a Member National Release and belongs to the specified Namespace;
• 3 characters and 7 digits - the file is an optional part of the IHTSDO International Release and belongs to the specified Namespace; or;
5.4.6 VersionDate element

5.4.6.1 Description

The VersionDate element of the filename identifies the SNOMED CT version with which the file is intended to be used. Its format is an 8-digit number in the pattern "YYYYMMDD", in compliance with the ISO 8601 standard.

5.4.6.2 Rules

The following rules apply to the content of this element:

- For Data Files ("sct", "der" or "res"), and for Documentation ("doc") with a status tag value of "Current", the value of this element should always be the same as the SNOMED CT version date with which the file is associated.
- For other file types, the VersionDate element will identify the (past) date of the SNOMED CT release for which the file was intended. A file distributed with a past version date has not been updated to reflect changes to SNOMED CT since that date, nor has it been validated as correct or appropriate for current use.

VersionDate refers to the official, published date of a SNOMED CT International Release, or of the National Release of an IHTSDO Member country, and may not always correspond to the actual date of distribution of any particular release.

5.4.7 Extension element

The extension element of the filename identifies the file format (encoding convention) of the file, such as "txt", "pdf" or "zip". It has a format of 1-4 alphanumeric characters.

5.5 Release Format 2 - Core Component Guide

This guide describes SNOMED CT Release Format 2 (RF2), to be used for official production releases of SNOMED CT. This format is not mandated for internal terminology development usage or as an interchange mechanism between terminology development systems.

The purpose of RF2 is to provide a format that is flexible, unambiguous and useful. Its primary aim is to strengthen SNOMED CT by providing a format that is simple and stable, while enabling innovation through adaptations to cater for changing requirements.

This specification was developed by harmonising proposals reviewed by the IHTSDO Enhanced Release Format Project Group, including:

- The “Alternate Release Format” proposed by NEHTA in coordination with their Australian Affiliates.

5.5.1 General

5.5.1.1 File Naming and Layout

In RF2, release files will be named predictably and in such a way as to avoid naming clashed between files in the International release and National releases. The basic pattern for SNOMED CT release
file names consist of five elements, separated by an underscore ("_"), followed by a full stop (".") and a file extension:

Full details of the file naming convention can be found in the "SNOMED CT File Naming Convention" document (see associated documentation). All release files:

- are UTF-8 encoded, tab delimited text files.
- contain a column header row, providing field names for each column within the file. Lower camel case is used for the field names (e.g. moduleId, effectiveTime).
- use DOS style line termination. Each line is terminated with a carriage return character followed by a line feed character.
- Should have a last line that ends with a line terminator (CR/LF) before the end of file.

5.5.1.2 Field Data Types

The following data types are used in the release files:

Table 34: Data Types Used in Release Files

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCTID</td>
<td>A SNOMED CT identifier, between 6 and 18 digits long, as described in SCTID Representation.</td>
</tr>
<tr>
<td>UUID</td>
<td>Universally Unique Identifier, 128-bit unsigned integer</td>
</tr>
<tr>
<td>Integer</td>
<td>32-bit signed integer.</td>
</tr>
<tr>
<td>String</td>
<td>UTF-8 text of a specified length.</td>
</tr>
<tr>
<td>Boolean</td>
<td>Boolean value, represented as one of two possible integer values (’1’ for true, ’0’ for false).</td>
</tr>
<tr>
<td>Time</td>
<td>For release files, a time format down to day of the year is used, having an ISO 8601 basic representation of YYYYMMDD. For development interchange formats, an ASCII text field in the ISO 8601 basic format YYYYMMDDThhmmssZ will be used. The time zone will always be UTC, as indicated by the trailing &quot;Z&quot;. (e.g. 20080602T223000Z represents 10:30pm June 2 2008 UTC.)</td>
</tr>
</tbody>
</table>

5.5.1.3 Metadata and Enumerated Values

Concept enumerations are used across all release files. A concept enumeration simply uses concepts in a metadata hierarchy to represent an enumerated value set rather than using arbitrary integer values directly. A concept enumeration will therefore use an SCTID data type.

Non-clinical metadata is separated from the SNOMED CT clinical content by holding the two types of data in two separate hierarchies. The concept named | SNOMED CT Model Component |, which is a child of the root concept | SNOMED CT Concept |, contains the metadata model that supports each release.

Underneath the | SNOMED CT Model Component | hierarchy, the | core metadata concept | sub-hierarchy contains concepts that are referenced from fields within other International Release files (the Concept, Description, Relationship, Identifier files).

The | foundation metadata concept | sub-hierarchy also sits below the | SNOMED CT Model Component | hierarchy. This sub-hierarchy contains the metadata that supports the extensibility mechanism, and is discussed in more detail in the Reference Sets Guide.
The third and forth sub-hierarchy under SNOMED CT Model Component are the linkage concept sub-hierarchy, which holds details of relationship types, and the namespace concept sub-hierarchy, which holds details of Namespaces.

For more information, see Concept Enumerations.

5.5.1.4 Identification of Source Module

A moduleId field, assigned to each component, helps identify the origin of content and dependencies in a release. This enables release centres to compose a unified release from a number of different modules, yet still identify the origin of content within the release. For example, module ids may be used to differentiate SNOMED CT International content, Australian Medicines terminology and Pathology content within the Australian National release.

Each component within a SNOMED CT release references a moduleId. This is the module in which the component is currently maintained. A module is simply a collection of SNOMED CT components that are maintained as a unit by a single organisation. It is the organisation's responsibility to organise the components in each extension that it is responsible for into one or more modules, in a way that best fits its business needs.

5.5.1.5 Meaning of the active field

Each component in RF2 has an associated active field, which can take values of true ('1') or false ('0'). The meaning of this flag is described by component type in the following table:

<table>
<thead>
<tr>
<th>Component Type</th>
<th>active value</th>
<th>Description of behaviour when most recent row representing a component has the specified active value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>True</td>
<td>• The Concept is intended for active use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All active Descriptions for which the conceptId refers to this Concept are valid. Visibility of these active Descriptions depends on information contained in applicable RefsetMembers (for example, whether the Description is in a language dialect reference set that is currently enabled in the vendor's system).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All active Relationships of which it is the sourceld or destinationld are applicable.</td>
</tr>
<tr>
<td>Concept</td>
<td>False</td>
<td>• The Concept is not intended for active use. However, it remains a valid concept for historical purposes as part of the SNOMED CT commitment to the principle of 'concept permanence'.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Valid Descriptions of the Concept remain active allowing it to be appropriately viewed in human-readable form.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• An inactive Concept cannot be the sourceld, destinationld or typeld of an active Relationship.</td>
</tr>
<tr>
<td>Description</td>
<td>True</td>
<td>• The Description contains a Term that is a valid description of the Concept referred to by the conceptId.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• An active Description may refer to an inactive Concept, in which case the Term provides a valid description of that inactive Concept. Text based searches should (by default) include only active Descriptions that refer to active Concepts.</td>
</tr>
<tr>
<td>Description</td>
<td>False</td>
<td>• The Description is not a valid and the associated Term should no longer be regarded as being associated with the Concept referred to by conceptId.</td>
</tr>
</tbody>
</table>
### 5.5.1.6 History Mechanism

The **effectiveTime** and **active** fields in the *release file* enable the use of a "log style" append-only data model to track all changes to each *component*, providing full traceability. Once released, a row in any of these files will always remain unchanged. Historic data is supplied in the *RF2 release files*, dating back to the first release in *RF1* format in 2002.

In order to change the properties of a current *component* (and, therefore, to create a new version of it), a new row is added to the applicable file, containing the updated fields, with the **active** field set to **true** and the timestamp in the **effectiveTime** field indicating the nominal date on which the new version was released.

To inactivate a *component*, a new row is added, containing the same data as the final valid version of the *component*, but with the **active** field set to **false** and the timestamp in the **effectiveTime** field indicating the nominal date of the release in which the final version ceased being valid.

Where editorial policy does not allow a particular property of a *component* to be changed whilst keeping the same **Identifier**, the *component* as a whole is inactivated (as described above), and a new row added with a new id, the **effectiveTime** set to the nominal date of the release in which this version of the *component* became valid, and the **active** field set to **true**.

It is thus possible to see both the current values and any historical values of a *component* at any point in time.

Content will not be future dated with respect to the release that it appears in, although a release itself may be released a few days before its nominal release date. Where there is a business requirement for specifying a future activation date for some *components*, this may be modelled using **reference sets**.

The following example demonstrates how the **history mechanism** works on the *Concept file*, but the same rules apply equally well to the *Description, Relationship* and *Reference set member files*. In this example, the **descriptions** associated with the **moduleId** and **definitionStatusId** have been shown in place of their **SCTID** values.

### Example

<table>
<thead>
<tr>
<th><strong>Component Type</strong></th>
<th><strong>active value</strong></th>
<th><strong>Description of behaviour when most recent row representing a component has the specified active value</strong></th>
</tr>
</thead>
</table>
| **Relationship**   | True             | • The **Relationship** represents a valid association of the type specified by the **typeld**, between two **Concepts** referred to by the **sourceId** and **destinationId**;  
|                    |                  | • An **inactive Concept** cannot be the **sourceId**, **destinationId** or **typeld** of an **active Relationship**. |
| **Relationship**   | False            | • The **Relationship** is not valid. An **inactive Relationship** should be ignored as it does not apply.  
|                    |                  | • This does not necessarily mean that the association indicated by the **Relationship** does not apply. The **Relationship** may be **inactive** because it is redundant and inferable based on other **active Relationships**.  
|                    |                  | • An **inactive Relationship** may refer to either **active** or **inactive components**. |
| **RefsetMember**   | True             | • The **RefsetMember** contains valid information applicable to the **component** referred to by the **referencedComponentId**.  
|                    |                  | • The **component** referred to by the **referencedComponentId** may be **active** or **inactive**. An **active RefsetMember** cannot make an **inactive component active** but may provide related information that continues to be relevant (e.g. the reason for inactivation). |
| **RefsetMember**   | False            | • The **RefsetMember** is not valid. An **inactive RefsetMember** should be ignored. The information it contains is not applicable to the **component** referred to by the **referencedComponentId**. |

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A new concept (101291009) is added on the 1st July 2007:

### Table 36: History Example - Concept Added

<table>
<thead>
<tr>
<th>Id</th>
<th>effectiveTime</th>
<th>active</th>
<th>moduleId</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>101291009</td>
<td>20070701</td>
<td>1</td>
<td>Module 1</td>
<td>900000000000074008</td>
</tr>
</tbody>
</table>

In the next release (on 1st January 2008), the concept is moved from Module 1 to Module 2. Because the moduleId field is not immutable, the concept may be updated simply by adding a new record with the same Id.

### Table 37: History Example - Module Change

<table>
<thead>
<tr>
<th>Id</th>
<th>effectiveTime</th>
<th>active</th>
<th>moduleId</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>101291009</td>
<td>20070701</td>
<td>1</td>
<td>Module 1</td>
<td>900000000000074008</td>
</tr>
<tr>
<td>101291009</td>
<td>20080101</td>
<td>1</td>
<td>Module 2</td>
<td>900000000000074008</td>
</tr>
</tbody>
</table>

In the next release (on 1st July 2008), the concept is changed from being Primitive to being Fully defined.

### Table 38: History Example - Definition Status Changed

<table>
<thead>
<tr>
<th>Id</th>
<th>effectiveTime</th>
<th>active</th>
<th>moduleId</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>101291009</td>
<td>20070701</td>
<td>1</td>
<td>Module 1</td>
<td>900000000000074008</td>
</tr>
<tr>
<td>101291009</td>
<td>20080101</td>
<td>1</td>
<td>Module 2</td>
<td>900000000000074008</td>
</tr>
<tr>
<td>101291009</td>
<td>20080701</td>
<td>1</td>
<td>Module 2</td>
<td>900000000000073002</td>
</tr>
</tbody>
</table>

In the next release (on 1st January 2009), the concept is deactivated:

### Table 39: History Example - Concept Made Inactive

<table>
<thead>
<tr>
<th>Id</th>
<th>effectiveTime</th>
<th>active</th>
<th>moduleId</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>101291009</td>
<td>20070701</td>
<td>1</td>
<td>Module 1</td>
<td>900000000000074008</td>
</tr>
<tr>
<td>101291009</td>
<td>20080101</td>
<td>1</td>
<td>Module 2</td>
<td>900000000000074008</td>
</tr>
<tr>
<td>101291009</td>
<td>20080701</td>
<td>1</td>
<td>Module 2</td>
<td>900000000000073002</td>
</tr>
<tr>
<td>101291009</td>
<td>20090101</td>
<td>0</td>
<td>Module 2</td>
<td>900000000000074008</td>
</tr>
</tbody>
</table>
Notes:

1. At no stage in this process are previously written records ever amended. Once a record has been released in a release file, it will continue to be released in exactly the same form in future release files.

2. Changes are only recorded at the point of release in the RF2 release files. If a component record is changed a number of times between releases (during an edit and review process), only the most recently amended record will be appended to the release file, not individual records showing each separate edit to the released component.

3. In the last example, as well as inactivating the concept (active=0), the definitionStatusId is changed from 900000000000073002 | Defined | to 900000000000074008 | Primitive |. In practice this change is not essential since the value of data columns is ignored when a component is inactive. Although the change is unnecessary and insignificant, it typically occurs since all the relationships of an inactive concept must also be inactive, and as a result, from the perspective of the authoring environment the concept cannot be regarded as 900000000000073002 | Defined |.

5.5.1.7 Release Types

Given the RF2’s history tracking capability, it is possible to perform a number of different releases of content:

Table 40: SNOMED CT Release Types

<table>
<thead>
<tr>
<th>Release Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>The files representing each type of component contain every version of every component ever released.</td>
</tr>
<tr>
<td>Snapshot</td>
<td>The files representing each type of component contain one version of every component released up to the time of the snapshot. The version of each component contained in a snapshot is the most recent version of that component at the time of the snapshot.</td>
</tr>
<tr>
<td>Delta</td>
<td>The files representing each type of component contain only component versions created since the previous release. Each component version in a delta release represents either a new component or a change to an existing component.</td>
</tr>
</tbody>
</table>

There are valid use cases for each type of Release Type. Each International release will incorporate all three of these Release Types, allowing users to choose the most appropriate format for their needs.

A full release will always be available from release centres. Optionally, other Release Formats may also be made available. Where out of cycles releases are made, these will follow the same format as standard cycle releases.

5.5.2 Relationships between files

The relationships between the records in the core files in the RF2 Release Format are depicted in the following diagram.
Each SNOMED CT concept is held as a single row in the Concept file. Each row represents a clinical concept.

Each concept has two or more descriptions associated with it (at least one synonym and at least one Fully Specified Name). Each description is held as a single row in the Description file, and may only refer to a single concept.

Each relationship, from a source concept to a destination concept, is held as a single row in the Relationship file. The type of each relationship is defined by reference to a linkage concept, also held within the Concept file.

The most basic form of relationship is the subsumption relationship, identifying that one concept is a kind of another concept. For example, an |Outpatient procedure| |Is a| |Procedure|. All the concepts in SNOMED CT form an |Is a| hierarchy, with a parent concept connected to each child concept by an |Is a| relationship.

In this hierarchy, a child concept may have more than one parent concept. The root of the hierarchy is the |SNOMED CT Concept|, which has 19 top level children, each forming its own sub-hierarchy. There are no |Is a| relationships that cross from one of these sub-hierarchies to another (e.g. from a concept in the Procedures sub-hierarchy to a concept in the Substances hierarchy.

In addition to the |Is a| relationships, other relationship types are also held within the Relationship file, such as |Finding site| or |Laterality|. Relationship types are specified under the |Linkage| sub-hierarchy in the |SNOMED CT Model component| hierarchy.

### 5.5.3 File formats

The following sections provide details of the format of the release files. An SQL schema, which represents the content of each of these files as a relational table, is provided as part of the Terminology Service Guide.
5.5.3.1 Concept file

The Concept file holds the clinical concepts that make up SNOMED CT. A concept is given meaning by its Fully Specified Name, which is held in the Description file. A concept may be distinguished from or refined by association with other concepts using relationships, which are held in the Relationship file.

Table 41: Concept file - Detailed Specification

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Immutable</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>Y</td>
<td>Uniquely identifies the concept.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>N</td>
<td>Specifies the inclusive date at which the component version's state became the then current valid state of the component</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>N</td>
<td>Specifies whether the concept's state was active or inactive from the nominal release date specified by the effectiveTime</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>N</td>
<td>Identifies the concept version's module. Set to a descendant of 900000000000443000</td>
</tr>
<tr>
<td>definitionStatusId</td>
<td>SCTID</td>
<td>N</td>
<td>Specifies if the concept version is primitive or fully defined. Set to a descendant of 900000000000444006</td>
</tr>
</tbody>
</table>

Only one concept record with the same id field is current at any point in time. The current record will be the one with the most recent effectiveTime before or equal to the date under consideration. If the active field of this record is false ('0'), then the concept is inactive at that point in time.

When a concept is made inactive, the following operations take place:

- A new row is added to the Concepts file for the concept, with the active flag set to inactive (as described in the section on the History Mechanism);
- All relationships that have as source the concept to be inactivated will themselves be inactivated by adding a new row to the Relationship file for each relationship, with the active flag set to inactive;
- All active descriptions associated with the concept will remain unchanged unless incorrect for the concept;
- Rows will be added as needed to the Historical Association Reference Set, to model associations from the inactive concept to other concepts;
- Active descriptions that are still associated with the inactive concept will be added to the Description inactivation indicator reference set, with an associated value of Concept non-current.

5.5.3.2 Description file

The Description file holds descriptions that describe SNOMED CT concepts. A description is used to give meaning to a concept and provide well-understood and standard ways of referring to a concept.
<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Immutable</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>Y</td>
<td>Uniquely identifies the description.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>N</td>
<td>Specifies the inclusive date at which the component version's state became the then current valid state of the component</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>N</td>
<td>Specifies whether the description's state was active or inactive from the nominal release date specified by the effectiveTime.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>N</td>
<td>Identifies the description version's module. Set to a child of 900000000000443000</td>
</tr>
<tr>
<td>conceptld</td>
<td>SCTID</td>
<td>Y</td>
<td>Identifies the concept to which this description belongs. Set to an Identifier of a concept in the 138875005</td>
</tr>
<tr>
<td>languageCode</td>
<td>String</td>
<td>Y</td>
<td>Specifies the language of the description text using the two character ISO-639-1 code. Note that this specifies a language level only, not a dialect or country code.</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td>Y</td>
<td>Identifies whether the description is an FSN, Synonym or other description type. This field is set to a child of 900000000000446008</td>
</tr>
<tr>
<td>term</td>
<td>String</td>
<td>N</td>
<td>The description version's text value, represented in UTF-8 encoding.</td>
</tr>
<tr>
<td>caseSignificanceId</td>
<td>SCTID</td>
<td>N</td>
<td>Identifies the concept enumeration value that represents the case significance of this description version. For example, the term may be completely case sensitive, case insensitive or initial letter case insensitive. This field will be set to a child of 900000000000447004</td>
</tr>
</tbody>
</table>
Only one description record with the same id field will be current at any point in time. The current record will be the one with the most recent effectiveTime before or equal to the point in time under consideration.

If the active field of this record is false (‘0’), then the description is inactive at that point in time. If the active field is true (‘1’), then the description is associated with the concept identified by the conceptId field.

The conceptId field, the languageCode field and the typeId field will not change between two rows with the same id, in other words they are immutable. Where a change is required to one of these fields, then the current row will be de-activated (by appending a row with the same id and the active field set to false) and a new row with a new id will be appended. Only limited changes may be made to the 'term' field, as defined by editorial rules.

Each concept will have at least one active description with a typeId of | Synonym | for a given languageCode (like "en"). Where a concept only has one active description with a typeId of | Fully Specified Name | for a given language code, then that Description can be taken as the Fully Specified Name for that language and each of its dialects, and need not therefore be explicitly included in language reference sets for that language. Where a concept only has one active description with a typeId of | Fully Specified Name | across all language codes within a release, then that Description can be taken as the Fully Specified Name for all languages and dialects, and need not therefore be explicitly included in any language reference sets in that release.

The Term field will be restricted as follows:

- to an overall maximum length of 32Kb;
- to a maximum length, configurable for each description type (as defined by the Description Type reference set member associated with that description type - see the "SNOMED CT Release Format 2 - Reference Set Specifications" document for more details);
- The format of the term field (plain text, limited HTML, XHTML, DITA) will also be configurable for each description type, using the same mechanism as above;
- Control characters (including TABs, CRs and LFs) will not appear in |Plain text| and |Limited HTML| format types.

5.5.3.3 Relationship file

The Relationship file holds one relationship per row. Each relationship is of a particular type, and has a source concept and a destination concept. An example of a relationship is given below:

| Outpatient procedure | | Is a | | Procedure | where:

- | Outpatient procedure | is the source concept;
- | Is a | is the relationship type concept; and;
- | Procedure | is the destination concept.

Table 43: Relationship file - Detailed Specification

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Immutable</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>Y</td>
<td>Uniquely identifies the relationship.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>N</td>
<td>Specifies the inclusive date at which the component version’s state became the then current valid state of the component</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>N</td>
<td>Specifies whether the relationship's state was active or inactive from the nominal release date specified by the effectiveTime field.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Immutable</td>
<td>Purpose</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>N</td>
<td>Identifies the relationship version's module. Set to a child of 900000000000443000</td>
</tr>
<tr>
<td>sourceId</td>
<td>SCTID</td>
<td>Y</td>
<td>Identifies the source concept of the relationship version, i.e., the concept the relationship version emanates from. Set to an Identifier of a concept in the Concept file.</td>
</tr>
<tr>
<td>destinationId</td>
<td>SCTID</td>
<td>Y</td>
<td>Identifies the concept that is the destination of the relationship version. Set to an Identifier of a concept in the Concept file.</td>
</tr>
<tr>
<td>relationshipGroup</td>
<td>Integer</td>
<td>N</td>
<td>Groups together relationship versions that are part of a logically associated relationship group. All active Relationship records with the same relationshipGroup number and sourceId are grouped in this way.</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td>Y</td>
<td>A concept enumeration value from the metadata hierarchy that identifies the semantic type of the relationship version. 116680003</td>
</tr>
<tr>
<td>characteristicTypeId</td>
<td>SCTID</td>
<td>N</td>
<td>A concept enumeration value that identifies the characteristic type of the relationship version (i.e. whether the relationship version is defining, qualifying, etc.) This field is set to a descendant of 900000000000449001</td>
</tr>
<tr>
<td>modifierId</td>
<td>SCTID</td>
<td>N</td>
<td>A concept enumeration value that identifies the type of Description Logic (DL) restriction (some, all, etc.). Set to a child of 9000000000000450001</td>
</tr>
</tbody>
</table>

Only one relationship record with the same id field will be current at any point in time. The current record will be the one with the most recent effectiveTime before or equal to the point in time under consideration.
If the *active* field of this record is false ('0'), then the *relationship* is *inactive* at that point in time. If the *active* field is true ('1'), then there is a *relationship* between the *SNOMED CT concepts* identified by *sourceId* and *destinationId*.

The *sourceId*, *destinationId*, *relationshipGroup*, *typedId*, *characteristicTypeId*, and *modifierId* will not change between two rows with the same id, in other words they are immutable. Where a change is required to one of these fields, then the current row will be de-activated (by appending a row with the same id and the *active* field set to false) and a new row with a new id will be appended.

The *relationshipGroup* field is used to group *relationships* with the same *sourceId* field into one or more logical sets. A *relationship* with a *relationshipGroup* field value of '0' is considered not to be grouped. All *relationships* with the same *sourceId* and non-zero *relationshipGroup* are considered to be logically grouped.

The *relationshipGroup* field will be an unsigned *integer*, and will not be limited to a single digit value. There is no guarantee that they will be assigned sequentially, and the values will not be unique across *concepts*.

The *modifierId* field will initially be set to 900000000000451002 | Some | to keep compatibility with the *RF1* release. Widening the range of this field to include other values (such as |All|) will in future increase the expressive power of *SNOMED CT*. However, this is likely to come at the cost of an increase in reasoning complexity, leading to potential issues for classification tooling.

**Notes:**

1. The modifierId field has been included at this stage as the *RF2* format is likely to be stable for at least a five year period, without addition or deletion of fields. Within that period it is anticipated that other modifierId values will be added. Therefore, although not fully implemented at this stage, this field has been included in the initial RF2 specification as it represents an integral part of the Description Logic used by *SNOMED CT*.

2. Any expansion of *SNOMED CT* to include *relationships* with a modifierId set to a value other than 900000000000451002 | Some | will be discussed with *Members* first and approved by the Technical Committee.

3. Changes have been made to the "Immutability" values shown in the above table in the 2014-07-31 version. These changes reflect the fact that the values in the following columns of a uniquely identified relationship have occurred in historical data and in these cases tracking the history of these changes is of greater value that insisting on immutability.
   - *relationshipGroup*: The number can change though the logical content of the group represented should not change. Additionally no significance should be read into the *relationshipGroup* value of an inactive *relationship*;
   - *characteristicType*: This has changed in historical data but should not change in future;
   - *modifierId*: Since there is currently only one value for this no changes are possible but if the permitted values are extended as suggested above then it is likely that changes would be required.

5.5.3.4 *Identifier file*

This file provides a standardised way of associating alternate *Identifiers* from various schemes with *SNOMED CT components*.

At any point in time, an alternate *Identifier* within a particular scheme will be associated with one and only one *SNOMED CT component*. A *SNOMED CT component* may be associated with zero or more alternate *Identifiers* within a single scheme.

It is important to note that the *SNOMED CT component* and its alternate *Identifiers* all identify precisely the same real-world object.

**Note:** The *Identifier file* is not currently used in the *SNOMED CT International Release* as use of the more flexible *Simple map type references set* structure is preferred for links to alternative codes. The only known current use of this file is for internal identification of components during the content development process.
Table 44: Identifier file - Detailed Specification

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Immutable</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>identifierSchemeld</td>
<td>SCTID</td>
<td>Y</td>
<td>Identifier of the concept enumeration value from the Metadata hierarchy that represents the scheme to which the Identifier value belongs. Set to a descendant of 900000000000453004</td>
</tr>
<tr>
<td>alternateldentifier</td>
<td>String</td>
<td>Y</td>
<td>String representation of the alternate Identifier in its native scheme.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>N</td>
<td>Specifies the inclusive date at which the alternate Identifier was associated with the SNOMED CT component.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>N</td>
<td>Specifies whether the association was active or inactive from the point in time specified by the effectiveTime.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>N</td>
<td>Identifies the source module that this association was created in. Set to a child of 900000000000443000</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>Y</td>
<td>Uniquely identifies the SNOMED CT component with which the alternate Identifier is associated.</td>
</tr>
</tbody>
</table>

Only one record with the same identifierSchemeld and alternateldentifier fields will be current at any point in time. The current record will be the one with the most recent effectiveTime before or equal to the point in time under consideration.

If the active field of this record is false ('0'), then the association is inactive at that point in time. If the active field is true ('1'), then there is an identity at that point in time between the referencedComponentId (a SNOMED CT component) and the alternateldentifier in the scheme identified by identifierSchemeld.

5.5.3.5 Transitive Closure History File

The Transitive Closure is the complete set of relationships between every concept and each of its super-type concepts, in other words both its parents and ancestors. A Transitive Closure History file can be generated from the SNOMED CT content using scripts provided with each release. The generated file will be of the following format and contain the valid states of the transitive closure of each concept across all previous releases:
Table 45: Transitive Closure History File - Detailed Specification

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>subtypeld</td>
<td>SCTID</td>
<td>Id of the concept playing the subtype role. Set to an Identifier of a concept.</td>
</tr>
<tr>
<td>supertypeld</td>
<td>SCTID</td>
<td>Id of the concept playing the supertype role. Set to an Identifier of a concept.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>Specifies the inclusive date at which the transitive closure record became valid.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>Specifies whether the Identifier version's state was active or inactive from the point in time specified by the effectiveTime.</td>
</tr>
</tbody>
</table>

5.5.4 Extensibility Mechanism

Reference set data structures provide the foundation pieces for RF2's generic extensibility mechanism. These building blocks provide a common foundation for extension owners to build on SNOMED CT. They also enable the Release Format to support changing requirements.

Conventions applied to the RF2 files such as field names, field order and history tracking have also been applied to the reference set specification. This has been done to provide consistency across all components in the Release Format.

5.5.4.1 The basic reference set member file format

The basic reference set data structure consists of the following fields:

Table 46: Basic Reference Set Data Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Immutable</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>Y</td>
<td>A 128 bit unsigned integer, uniquely identifying the reference set member.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>N</td>
<td>Specifies the inclusive date at which this change becomes effective.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>N</td>
<td>Specifies whether the member's state was active or inactive from the nominal release date specified by the effectiveTime field.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>N</td>
<td>Identifies the member version's module. Set to a child of 900000000000443000</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Immutable</td>
<td>Purpose</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Y</td>
<td>Uniquely identifies the reference set that this extension row is part of. Set to a descendant of 900000000000455006</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID or UUID</td>
<td>Y</td>
<td>Uniquely identifies the component that this row relates to, thus defining membership of this component in the Reference Set. This field can be set to the Identifier of a record within the Concept, Description, Relationship or Reference Set member file. However, the content of this field can be further restricted for each reference set by the reference set descriptor (see the &quot;SNOMED CT Release Format 2 - Reference Set Specifications&quot; document for more details).</td>
</tr>
<tr>
<td>Zero or more other fields</td>
<td>SCTID, String, or Integer</td>
<td>N</td>
<td>Optional field</td>
</tr>
<tr>
<td>...</td>
<td>SCTID, String, or Integer</td>
<td>N</td>
<td>Optional field</td>
</tr>
</tbody>
</table>

Each reference set will be defined as a concept in the metadata hierarchy.

There will be one active row in the above table for each member of the reference set. Individual reference set members will be uniquely identified using a UUID. Each Reference Set member will belong to a single Reference Set (referred to by the refsetId field) and will also reference the member component that belongs to that reference set (using the referencedComponentId field). The member component may be a Concept, Description, Relationship or a RefSet member itself.

Only one reference set member record with the same id field will be current at any point in time. The current record will be the one with the most recent effectiveTime before or equal to the point in time under consideration.

If the active field of this record is false (‘0’), then the reference set member is inactive at that point in time. If the active field is true (‘1’), then the component referenced by the referencedComponentId field is deemed to be a member of the reference set identified by the refsetId field.

The refsetId and referencedComponentId fields will not change between two rows with the same id, in other words they are immutable. Where a change is required to one of these fields, then the current row will be de-activated (by appending a row with the same id and the active field set to false) and a new row with a new id will be appended.

A component may belong to any number of reference sets and to each reference set more than once. In the latter case, there will be more than one row with the same refsetId and referencedComponentId, each having different id fields, so co-existing at the same time.

### 5.5.4.2 Extending the basic reference set member file format

The reference set member file structure may be extended by addition of one or more fields. Each of these fields will hold additional values specific to each member. Data types that are supported in the additional columns are:

- **Integer**
• **String**
• **Component** (a reference to a SNOMED CT component).

Finer grained interpretation of the values is based on the 900000000000456007 | Reference set descriptor |. Further details can be found in the Reference set specifications.

The different Reference Set patterns that are supported will depend on a documented set of use cases. The supported patterns will expand over time as further use cases are identified.

### 5.5.5 Metadata hierarchy

As the release file formats contain a number of concept enumerations, it is necessary to define sets of concepts that represent the allowed values. As well as the enumerated values, other metadata supporting the extensibility mechanism and the concept model is required.

The concept | SNOMED CT Model Component (metadata) | is a subtype of the root concept ( | SNOMED CT Concept |), and contains the metadata, supporting the release.

The subtypes of | SNOMED CT Model Component (metadata) | are described in Table 47 and the top three levels of the hierarchy are shown in Figure 38.

**Table 47: SNOMED CT Model Component (metadata) (900000000000441003)**

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
</table>
| 106237007 | Linkage concept | Concepts that specify
- Semantic Relationships between concepts ( | Attribute |); and
- Asserted associations between statements in a record ( | Link assertion |) |
| 370136006 | Namespace concept | Concepts that specify the Extension Namespaces allocated by the IHTSDO. |
| 900000000000442005 | Core metadata concept | Concepts that are referenced from enumerated fields within the International Release files (the Concept, Description, Relationship, Identifier files). |
| 900000000000445007 | Foundation metadata concept | The metadata that supports the extensibility mechanism, and is discussed in more detail in the Reference Sets Guide. |

• 138875005 | SNOMED CT Concept |
• ... (content hierarchies) ...
• 900000000000441003 | SNOMED CT Model Component |
  • 106237007 | linkage concept |
  • 246061005 | attribute | ...
  • 416698001 | link assertion | ...
  • 370136006 | namespace concept | ...
  • 900000000000442005 | core metadata concept |
  • 900000000000443000 | module |
  • 900000000000445007 | IHTSDO maintained module | ...
• 900000000000444000 | definition status |
  • 900000000000073000 | defined |
  • 900000000000074000 | primitive |
• 900000000000446000 | description type |
  • 900000000000030001 | fully specified name |
  • 900000000000013000 | synonym |
  • 900000000000055000 | definition |
• 900000000000447000 | case significance |
  • 900000000000017005 | case sensitive |
  • 900000000000020002 | only initial character case insensitive |
  • 9000000000000448009 | case insensitive |
• 900000000000449000 | characteristic type |
  • 900000000000006009 | defining relationship |
  • 900000000000225001 | qualifying relationship |
  • 900000000000227009 | additional relationship |
• 900000000000450000 | modifier |
  • 9000000000000451002 | some |
  • 9000000000000452009 | all |
• 900000000000453000 | identifier scheme |
  • 900000000000020006 | SNOMED CT UUID |
  • 9000000000000294009 | SNOMED CT integer identifier |
• 900000000000454005 | foundation metadata concept |
• 900000000000455000 | reference set |
  • 9000000000000456007 | reference set descriptor |
  • 9000000000000480006 | attribute value type |
  • 9000000000000496009 | simple map |
  • 9000000000000506000 | language type |
  • 9000000000000512005 | query specification type |
  • 9000000000000516008 | annotation type |
  • 9000000000000521006 | association type |
  • 9000000000000534007 | module dependency |
  • 9000000000000538005 | description format |
• 900000000000457000 | reference set attribute |
  • 9000000000000458008 | attribute description |
  • 9000000000000459000 | attribute type |
  • 9000000000000479008 | attribute order |
  • 9000000000000491004 | attribute value |
  • 9000000000000499002 | scheme value |
  • 9000000000000500006 | map source concept |
  • 9000000000000501005 | map group |
  • 9000000000000502003 | map priority |
  • 9000000000000503008 | map rule |
  • 9000000000000504002 | map advice |
  • 9000000000000505001 | map target |
  • 9000000000000510002 | description in dialect |
  • 9000000000000511003 | acceptability |
5.6 Release Format 2- Reference Sets Guide

5.6.1 Introduction

This guide describes the reference set specifications released as part of the SNOMED CT Release Format 2. This format is not mandated for internal terminology development usage or as an interchange mechanism between terminology development systems.

The purpose of RF2 is to provide a format that is flexible, unambiguous and useful. Its primary aim is to strengthen SNOMED CT by providing a format that is simple and stable, while enabling innovation through adaptations to cater for changing requirements.

This format specification was developed by harmonising proposals reviewed by IHTSDO Enhanced Release Format Project Group, including:

- Alternate Release Format proposed by NEHTA in coordination with their Australian Affiliates.

5.6.1.1 Associated Quality Measures

Although the definition of quality measures to monitor the implementation of this standard do not fall under the scope of this guide, they will be covered by the documentation covering the QA and Release process for the Workbench.

5.6.1.2 Separation of Reference Sets into Release files

Separation of reference sets into files may be done in a number of ways. Each reference set will have a particular structure for the optional fields that are appended to each member. For example, a simple reference set will have no additional fields; a CSI reference set will have three additional fields - the first a component, the second a String, and the third an Integer. There must be at least one reference set member file for each different reference set structure, as defined above. Reference sets may be further split, if required, by the owner of the reference sets. The naming conventions for the reference set files provide more detail on the naming convention to be used in this case (see the “SNOMED CT File Naming Convention” document).
Each reference set file will have a header row containing field names for each of the columns. The names of the standard fields will be the field names as detailed in the "SNOMED CT Release Format 2 - Data Structures Specification" document.

In release files the additional fields will be named in accordance with the relevant row in "Reference Set Descriptor reference set".

Note: When imported by an application the release file names of additional attributes may be substituted by a more generic name to allow reference sets with a similar pattern of additional fields to be represented in a single table. In this case the "Reference Set Descriptor reference set" provides a link to the original name of the field in the distribution file.

5.6.2 Reference Set Specifications

This section first details how reference sets themselves are described in a machine readable form, using a set of | Reference set descriptor| member records (called a Descriptor, for short). It then describes a number of standard reference set patterns. Each of these patterns is also described in a machine readable form using a set of | Reference set descriptor| member records (called a Descriptor Template, for short). Each pattern may be used to define a number of reference sets. At the end of the section, a number of individual reference sets are described that do not conform to a particular pattern.

In each subsection, each reference set or reference set pattern is described in turn:

• The purpose of each reference set is first described;
• The format of the reference set member record is detailed in a table;
• The metadata supporting the reference set is described;
• The machine readable reference set descriptor member records for the reference set pattern (the Descriptor Template, for short) are then shown;
• Examples of usage are given, providing example Descriptors, where appropriate.

The first reference set to be described is the reference set descriptor. Subsequent sections describe a number of reference set patterns.

5.6.2.1 Overview
5.6.2.1.1 Descriptors, Descriptor Templates and Patterns

The purpose of the | Reference set descriptor| is to describe the format of all other reference sets that may be included in a release. A Descriptor held within the | Reference set Descriptor| describes the referencedComponentId field and the additional fields for the reference sets it describes. Each field is described using a concept in the metadata. The type of each field is also described in the same way.

Patterns allow a number of different types of reference set to be defined, each of which will conform to the specified pattern, having the same release file format. The file format of each reference set pattern is described by a Descriptor Template. This Descriptor Template describes the format and number of additional fields held against members of reference sets conforming to the pattern, and provides an envelope within which those additional fields may be further refined for each reference set conforming to the pattern. The Descriptor Template for each pattern is provided in the section describing that pattern.

Each defined reference set that conforms to a pattern will have its own Descriptor, that describes its own specific properties, and although reference set field types must still conform to the Descriptor Template for the pattern, each field type may be further constrained using data sub-types specified in the metadata hierarchy. This provides some level of refinement to the constraints that may be applied to a reference set conforming to a particular pattern.
5.6.2.1.2 Patterns and Use Cases

The next table summarises the use cases for reference sets (one per row) that are described in the following sections, and shows which reference set patterns are used in each case:
<table>
<thead>
<tr>
<th>Use cases</th>
<th>Patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Attribute value type</td>
</tr>
<tr>
<td>Refinability of relationships</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*</td>
</tr>
<tr>
<td>ICD-10 mapping</td>
<td>*</td>
</tr>
<tr>
<td>Inactivation indicator</td>
<td>*</td>
</tr>
<tr>
<td>CVT3 map</td>
<td>*</td>
</tr>
<tr>
<td>SNOMED RT map</td>
<td>*</td>
</tr>
<tr>
<td>Language dialect</td>
<td></td>
</tr>
<tr>
<td>Language dialect with context</td>
<td></td>
</tr>
<tr>
<td>Intension reference set specification</td>
<td></td>
</tr>
<tr>
<td>Image annotation</td>
<td></td>
</tr>
<tr>
<td>Short annotation</td>
<td></td>
</tr>
<tr>
<td>Descriptive annotation</td>
<td></td>
</tr>
<tr>
<td>reason for inactivation</td>
<td></td>
</tr>
<tr>
<td>Use cases</td>
<td>Patterns</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>RF1 Subset representation</td>
<td></td>
</tr>
<tr>
<td>Attribute value type</td>
<td>(C)</td>
</tr>
<tr>
<td>Simple map</td>
<td>(S)</td>
</tr>
<tr>
<td>Complex map</td>
<td>(IISSSC)</td>
</tr>
<tr>
<td>Language</td>
<td>(C)</td>
</tr>
<tr>
<td>Query Specification</td>
<td>(CCS)</td>
</tr>
<tr>
<td>Annotation</td>
<td>(S)</td>
</tr>
<tr>
<td>Association</td>
<td>(C)</td>
</tr>
<tr>
<td>Ordered</td>
<td>(IC)</td>
</tr>
<tr>
<td>Simple</td>
<td></td>
</tr>
</tbody>
</table>

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CVR #: 30363434
Release File Specifications | 147
Note: The letters shown after each pattern indicate the type and number of additional fields held against each member of a reference set conforming to that pattern, where ‘C’ is short for component, ‘S’ is short for String and ‘I’ is short for Integer.

Example: Reference sets conforming to the | Attribute value type| (C) pattern will have one additional field held against each member, a component reference; reference sets conforming to the |Simple type| pattern will have no additional fields held against each member.

5.6.2.1.3 Metadata Supporting Reference Sets

Reference sets are described by concepts under the | Reference set | sub-hierarchy.

• 900000000000455006 | reference set |
  • 900000000000456007 | reference set descriptor |
  • 900000000000480006 | attribute value type |
  • 900000000000496009 | simple map |
  • 900000000000506000 | language type |
  • 900000000000512005 | query specification type |
  • 900000000000516008 | annotation type |
  • 900000000000521006 | association type |
  • 900000000000534007 | module dependency |
  • 900000000000538005 | description format |

Figure 40: Reference Sets in the Metadata Hierarchy

Values that can be used within reference set fields are described in the | Reference set attribute | sub-hierarchy.

• 900000000000457003 | reference set attribute |
  • 900000000000458008 | attribute description |
  • 900000000000459000 | attribute type |
  • 900000000000479008 | attribute order |
  • 900000000000491004 | attribute value |
  • 900000000000499002 | scheme value |
  • 900000000000500006 | map source concept |
  • 900000000000501005 | map group |
  • 900000000000502003 | map priority |
  • 900000000000503008 | map rule |
  • 900000000000504002 | map advice |
  • 900000000000505001 | map target |
  • 900000000000510002 | description in dialect |
  • 900000000000511003 | acceptability |
  • 900000000000514006 | generated reference set |
  • 900000000000515007 | query |
  • 900000000000518009 | annotated component |
  • 900000000000519001 | annotation |
  • 900000000000532006 | association source component |
  • 900000000000533001 | association target component |
  • 900000000000535008 | dependency target |
  • 900000000000536009 | source effective time |
  • 900000000000537000 | target effective time |
  • 900000000000539002 | description format |
  • 900000000000544009 | description length |

Figure 41: Reference Set Attributes Metadata Hierarchy
The way that each of the concepts shown in this metadata hierarchy is used is described in each of the following sections.

5.6.2.1.4 Naming Conventions for Reference Sets

National Release Centres and others may create additional reference sets. A namespace is required to create a new reference set, as each reference set is defined by a Concept. The Concept’s FSN and a Synonym are used to name the reference set. Where a new reference set is created against an existing pattern, then the following naming convention should be used (where the text "My particular" should be replaced by the name of the reference set):

**Attribute value type reference set (pattern)**

FSN = My particular attribute value reference set (foundation metadata concept)

PT = My particular reference set

**Simple Map type reference set (pattern)**

FSN = My particular simple map reference set (foundation metadata concept)

PT = My particular simple map

**Complex Map type reference set (pattern)**

FSN = My particular complex map reference set (foundation metadata concept)

PT = My particular complex map

**Language type reference set (pattern) - for a Language refset**

FSN = English - ISO 639-1 code 'en' language reference set (foundation metadata concept)

PT = English

**Language type reference set (pattern) - for a Dialect RefSet**

FSN = GB English language reference set (foundation metadata concept)

PT = GB English

**Query specification type reference set (pattern)**

FSN = My particular query specification reference set (foundation metadata concept)

PT = My particular query specification reference set

**Annotation type reference set (pattern)**

FSN = My particular annotation reference set (foundation metadata concept)

PT = My particular annotation reference set

**Association type reference set (pattern)**

FSN = My particular association reference set (foundation metadata concept)

PT = My particular association reference set

5.6.2.2 Reference Set Descriptor

5.6.2.2.1 Purpose

The 900000000000456007 | Reference set descriptor | is a reference set that used to specify the format of all reference sets included in a release. The data type and meaning of the referenced component and each additional field within each reference set is described by this reference set.

Reference set descriptor can be used to define

- The order of appearance of additional attributes (other than those mandatory for all reference sets);
- The name and purpose of the additional attributes;
- The data types for the additional attributes.

This allows for a reference set to be validated using the metadata embedded within the reference set descriptor in the following ways:
• the data type of its attributes may be validated against the data type declared in the reference set descriptor;
• the column order can be checked against the reference set descriptor.

5.6.2.2.2 Data structure

The Reference set descriptor reference set is a Component - Component - Integer reference set that specifies the structure of reference sets. Its structure is shown in the following table.

Table 49: Reference set descriptor reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time T is the version with the most recent effectiveTime prior to or equal to time T.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to 900000000000456007</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>Identifies the reference set (or type of reference set) that is specified by this descriptor. Set to a descendant of 9000000000000455006</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>attributeDescription</td>
<td>SCTID</td>
<td>Specifies the name of an attribute that is used in the reference set to which this descriptor applies. Set to a descendant of 900000000000457000</td>
</tr>
<tr>
<td>attributeType</td>
<td>SCTID</td>
<td>Specifies the data type of this attribute in the reference set to which this descriptor applies. Set to a descendant of 900000000000459000</td>
</tr>
<tr>
<td>attributeOrder</td>
<td>Integer</td>
<td>Specifies the position of this attribute in the reference set to which this descriptor applies. A zero value identifies the referencedComponentId within the reference set. Other values specify an additional attributes by its position relative to the referencedComponentId. Within a particular descriptor, attributeOrder values for a particular referencedComponentId must be contiguous. An unsigned integer, providing an ordering for the additional attributes extending the reference set.</td>
</tr>
</tbody>
</table>

At least one row must exist for each reference set included in a release. This row must have an attributeOrder value of '0' and an attributeType of 'component type' (or one of its descendants). The referencedComponentId identifies the reference set defined by the descriptor.

There is one additional row for each additional column present in the specified reference set.

Creation of Reference set descriptor data is mandatory when creating a new reference set in the International Release or in a National Extension.

Creation of a Reference set descriptor is optional when creating a reference set in another Extension. If a descriptor is not created, the descriptor of the closest ancestor of the reference set is used when validating reference set member records.

5.6.2.2.3 Metadata

The following metadata in the |Foundation metadata concept | hierarchy supports the reference set descriptor reference set.

The Reference Set Descriptor Reference Set is specified by the 900000000000456007 | Reference set descriptor | concept in the metadata hierarchy.

- 900000000000441003 | SNOMED CT Model Component |
- 900000000000454005 | Foundation metadata concept |
- 900000000000455006 | Reference set |
Figure 42: Reference Set Descriptor Concept in the Metadata Hierarchy

Values in the Reference Set are populated from:

- 900000000000454005 | Foundation metadata concept |
  - 900000000000457003 | Reference set attribute |
    - 900000000000458008 | Attribute description |
    - 900000000000459000 | Attribute type |
      - 900000000000460005 | Component type |
        - 900000000000461009 | Concept type component |
        - 900000000000462002 | Description type component |
        - 900000000000463007 | Relationship type component |
        - 900000000000464001 | Reference set member type component |
    - 900000000000465000 | String |
      - 900000000000466004 | Text |
        - 900000000000467008 | Single character |
        - 900000000000468003 | Text < 256 bytes |
    - 900000000000469006 | URL |
      - 900000000000470007 | HTML reference |
      - 900000000000471006 | Image reference |
    - 900000000000472003 | UUID |
    - 900000000000473002 | Time |
  - 900000000000474003 | String |
    - 900000000000475002 | Time |
  - 900000000000476001 | Integer |
    - 900000000000477005 | Signed integer |
    - 900000000000478000 | Unsigned integer |
  - 900000000000479008 | Attribute order |
    - 900000000000480004 | Attribute value |

Figure 43: Reference Set Attribute Metadata Hierarchy

5.6.2.2.4 Descriptor
The table below shows the descriptor that defines the structure of the 900000000000456007 | Reference set descriptor |.

Table 50: Refset Descriptor rows for 900000000000456007 | Reference set descriptor |.

<table>
<thead>
<tr>
<th>refsetid</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000046007</td>
<td>9000000000000456007</td>
<td>449608002</td>
<td>Referenced component</td>
<td>9000000000000461009</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Reference set descriptor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900000000000046007</td>
<td>9000000000000456007</td>
<td>9000000000000458008</td>
<td>Attribute description</td>
<td>9000000000000461009</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Reference set descriptor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900000000000046007</td>
<td>9000000000000456007</td>
<td>9000000000000459000</td>
<td>Attribute type</td>
<td>9000000000000461009</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Reference set descriptor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900000000000046007</td>
<td>9000000000000456007</td>
<td>9000000000000479008</td>
<td>Attribute order</td>
<td>9000000000000478000</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Reference set descriptor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The table above omits the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the table above also includes the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.3 Simple Reference Set

5.6.2.3.1 Purpose

A 446609009 | Simple type reference set | allows a set of components to be specified for inclusion or exclusion for a specified purpose. This type of reference set represents an extensional definition of a subset of SNOMED CT components. Thus it can be used to fully enumerate a subset of concepts, descriptions or relationships.

See also Query specification reference set, which can be used to represent an intensional definition of a subset of SNOMED CT components. In an intensional definition, the members of the subset are specified by rules rather than by enumerations (e.g. all subtypes of a specified concepts).

5.6.2.3.2 Reference Set Data Structure

A Simple reference set does not have any addition fields.

Table 51: Simple Reference Set - Data Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time T is the version with the most recent effectiveTime prior to or equal to time T.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to 900000000000456007</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying the reference set member.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>Specifies the inclusive date at which this change becomes effective.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>Specifies whether the member’s state was active or inactive from the nominal release date specified by the effectiveTime field.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>Identifies the member version's module. Set to a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>Set to a child of</td>
</tr>
<tr>
<td>referencedComponentld</td>
<td>SCTID</td>
<td>A reference to the SNOMED CT component to be included in the reference set.</td>
</tr>
</tbody>
</table>

### 5.6.2.3.3 Metadata

Simple Reference Sets are subtypes of 446609009 | Simple type reference set | in the metadata hierarchy.

- 900000000000441003 | SNOMED CT Model Component |
  - 900000000000454005 | Foundation metadata concept |
    - 900000000000455006 | Reference set |
    - 446609009 | Simple type reference set |

**Figure 44: Simple Reference Sets in the Metadata Hierarchy**

### 5.6.2.3.4 Descriptor template
The table below shows the descriptor for a specific reference sets that follows the 446609009 | Simple type reference set | pattern.

Table 52: Refset Descriptor rows for 447566000 | Virtual medicinal product simple reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>447566000</td>
<td>Virtual medicinal product simple reference set</td>
<td>449608002</td>
<td>Referenced component</td>
</tr>
</tbody>
</table>

Note: The table above omits the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the table above also shows the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.3.5 Simple reference set example

Table 53: Sample content from 447565001 | Virtual therapeutic moiety simple reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
</tr>
</thead>
<tbody>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
<tr>
<td>447565001</td>
<td>Virtual therapeutic moiety simple reference set</td>
</tr>
</tbody>
</table>

5.6.2.4 Ordered Reference Set

5.6.2.4.1 Purpose

An 447258008 | Ordered type reference set | allows a collection of components to be defined with a specified given a priority ordering. This type of reference set can also be used to specify ordered associations between different components. These can be used to specify several interrelated subsets of components and to define alternative hierarchies for navigation and selection of concepts or descriptions.

5.6.2.4.2 Data structure

An Ordered reference set is an Integer Component reference set is used to represent ordered lists and alternative hierarchies. Its structure is shown in the following table.
### Table 54: Ordered reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time T is the version with the most recent effectiveTime prior to or equal to time T.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to a subtype of 447258008</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>The identifier of a SNOMED CT component that is included in the ordered list of alternative hierarchy.</td>
</tr>
</tbody>
</table>
### Field | Data type | Purpose
--- | --- | ---
*order* | *Integer* | Specifies the sort *order* of the list. The list is ordered by applying an ascending sort of the *order* value.

The value of *order*=1 represents the highest priority. A value of '0' is not allowed. Duplicate values are permitted and the sort order between two members with the same order value is not defined.

If the *linkedToId* value is not 0, sorting occurs within subgroups that share the same *linkedToId* value.

**Note:** The name "order" is a reserved word in some database environments. Please consider this when using this column.

*linkedToId* | *SCTID* | The identifier of a SNOMED CT component that acts as a grouper or hierarchy node, collecting together a subgroup from within the list.

This field either enables *reference set member* linked into a number of subgroups. These subgroups can be nested allowing representation of alternative hierarchies.

To link members into a subgroup, all components in the same subgroup should reference the same *component*. This can either be a component that represents the name of that subgroup or the first member of the subgroup. In the latter case, the first row of each subgroup will contain the same identifier in *referencedComponentId* and *linkedToId* and with *order*=1.

To link a number of *children concepts* to a single parent *concept*, one member record should exist per *child*, with the *referencedComponentId* field referencing the parent and this field referencing the *child concept*. The *order* field is then used to *order* the *children concepts* under the parent *concept*.

For ordered lists that do not require grouping or hierarchical arrangement the value of *linkedToId* should be the digit zero (0).

### 5.6.2.4.3 Metadata

The following metadata in the "Foundation metadata concept hierarchy" supports this *reference set*:

- 900000000000454005 | Foundation metadata concept |
- 900000000000455006 | Reference set |
447258008 | Ordered type reference set | ...

Figure 45: Ordered References Sets in the Metadata Hierarchy

5.6.2.4.4 Descriptor template and examples
The tables below show the descriptor that defines the structure of the 447258008 | Ordered type reference set | pattern and an example of descriptor for a specific reference set that follows this pattern.

Table 55: Refset Descriptor rows for 447258008 | Ordered type reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>attributeDescription</th>
<th>attributeType</th>
<th>attributeOrder</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>447258008</td>
<td>Ordered type reference set</td>
<td>449608002</td>
<td>Referenced component</td>
</tr>
<tr>
<td></td>
<td>447258008</td>
<td>Ordered type reference set</td>
<td>9000000000000460005</td>
<td>Component type</td>
</tr>
<tr>
<td>[9000000000000456007</td>
<td>447258008</td>
<td>Ordered type reference set</td>
<td>447255006</td>
<td>Priority order reference set attribute</td>
</tr>
<tr>
<td></td>
<td>447258008</td>
<td>Ordered type reference set</td>
<td>9000000000000478000</td>
<td>Unsigned integer</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447258008</td>
<td>Ordered type reference set</td>
<td>447257003</td>
<td>&quot;Linked to&quot; reference set attribute</td>
</tr>
<tr>
<td></td>
<td>447258008</td>
<td>Ordered type reference set</td>
<td>9000000000000460005</td>
<td>Component type</td>
</tr>
</tbody>
</table>

Table 56: Refset Descriptor rows for 447570008 | SNOMED CT top level navigation hierarchy ordered reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>449608002</td>
<td>Referenced component</td>
</tr>
<tr>
<td></td>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>9000000000000461009</td>
<td>Concept type component</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>9000000000000479008</td>
<td>Attribute order</td>
</tr>
<tr>
<td></td>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>9000000000000478000</td>
<td>Unsigned integer</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>447257003</td>
<td>&quot;Linked to&quot; reference set attribute</td>
</tr>
<tr>
<td></td>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>9000000000000461009</td>
<td>Concept type component</td>
</tr>
</tbody>
</table>

Note: The table above omits the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the table above also shows the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
### 5.6.2.4.5 Ordered reference set example

Table 57: Sample content from 447570008 | SNOMED CT top level navigation hierarchy ordered reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>order (Attribute order)</th>
<th>linkedTo (&quot;Linked to&quot; reference set attribute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>1</td>
<td>123946008</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>2</td>
<td>370117001</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>3</td>
<td>278919001</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>4</td>
<td>74732009</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>5</td>
<td>39898005</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>6</td>
<td>370118006</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>7</td>
<td>370119003</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>8</td>
<td>370120009</td>
</tr>
<tr>
<td>447570008</td>
<td>SNOMED CT top level navigation hierarchy ordered reference set</td>
<td>9</td>
<td>370121008</td>
</tr>
</tbody>
</table>
### 5.6.2.5 Attribute Value Reference Set

#### 5.6.2.5.1 Purpose

An | attribute value type reference set | allows a value from a specified range to be associated with a | component. This type of | reference set | can be use for a range of purposes where there is a requirement to provide additional information about particular | concepts, descriptions or relationships. For example, an | attribute value type reference set | is used to indicate the reason why a | concepts | has been | inactivated.

#### 5.6.2.5.2 Data Structure

A | attribute value reference set | is a | component reference set | used to apply a tagged value to a | SNOMED CT component. Its structure is shown in the following table.

| Table 58: Attribute value reference set - Data structure |

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the <strong>SNOMED CT module</strong> that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to a subtype of 900000000000480006</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>A reference to the <strong>SNOMED CT component</strong> being tagged with a value.</td>
</tr>
<tr>
<td>valueId</td>
<td>SCTID</td>
<td>The tagged value applied to the referencedComponentId. A subtype of 900000000000491004</td>
</tr>
</tbody>
</table>

### 5.6.2.5.3 Metadata
The following metadata in the "Foundation metadata concept hierarchy supports this reference set:

- 900000000000454005 | Foundation metadata concept |
  - 900000000000455006 | Reference set |
    - 900000000000480006 | Attribute value type |
      - 900000000000488004 | Relationship refinability reference set |
      - 900000000000489007 | Concept inactivation indicator reference set |
      - 900000000000490003 | Description inactivation indicator reference set |
      - 900000000000547002 | Relationship inactivation indicator reference set |

**Figure 46: Attribute Value Reference Sets in the Metadata Hierarchy**

### 5.6.2.5.4 Descriptor template and examples
The tables below show the descriptors that define examples of *reference sets* that follow the pattern.

### Table 59: Refset Descriptor rows for 9000000000000489007 | Concept inactivation indicator reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>9000000000000489007</td>
<td>Concept inactivation indicator reference set</td>
<td>449608002</td>
<td>Referenced component</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>9000000000000489007</td>
<td>Concept inactivation indicator reference set</td>
<td>9000000000000481005</td>
<td>Concept inactivation value</td>
</tr>
</tbody>
</table>

### Table 60: Refset Descriptor rows for 9000000000000490003 | Description inactivation indicator reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>9000000000000490003</td>
<td>Description inactivation indicator reference set</td>
<td>449608002</td>
<td>Referenced component</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>9000000000000490003</td>
<td>Description inactivation indicator reference set</td>
<td>9000000000000493001</td>
<td>Description inactivation value</td>
</tr>
</tbody>
</table>

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern *id, effectiveTime, active, moduleId*. Additionally, to aid understanding, the tables above also show the *term* from one of the *descriptions* associated with each of the identified *concept*. The release file only contains the *identifier*. 
### 5.6.2.5.5 Attribute Value reference set example

Table 61: Sample content from 900000000000489007 | Concept inactivation indicator reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>valueld (Concept inactivation value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000489007</td>
<td>105000</td>
<td>Poisoning by pharmaceutical excipient</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>123008</td>
<td>Channel catfish virus disease</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>141000</td>
<td>Glaucoma as birth trauma</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>157000</td>
<td>AIDS with low vision</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>190000</td>
<td>Partial hysterectomy</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>203004</td>
<td>Replacement of pacemaker in brain</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>212002</td>
<td>Salmonella III arizonae 53:k:z</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>215000</td>
<td>Operative procedure on fingers</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>220000</td>
<td>Unspecified monoarthritis</td>
</tr>
<tr>
<td>900000000000489007</td>
<td>236003</td>
<td>Incision of vein</td>
</tr>
</tbody>
</table>

### 5.6.2.6 Simple Map Reference Set

#### 5.6.2.6.1 Purpose

A 900000000000496009 | Simple map reference set | allows representation of simple maps between SNOMED CT concepts and values in other code systems. No constrains are put on the number of coding schemes supported, the number of codes within a particular scheme mapped to by a single SNOMED CT concept or the number of SNOMED CT concepts mapping to a particular...
code. However, this type of reference set is usually only appropriate where there is a close “one-to-one” mapping between SNOMED CT concepts and coded values in another code system.

5.6.2.6.2 Data structure

A Simple map reference set is a String reference set used to represent one-to-one maps between SNOMED CT concepts and codes in another terminology, classification or code system. Its structure is shown in the following table.

Table 62: Simple map reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time $T$ is the version with the most recent effectiveTime prior to or equal to time $T$.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to a subtype of 900000000000496009</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>The identifier of the SNOMED CT concept being mapped.</td>
</tr>
<tr>
<td>mapTarget</td>
<td>String</td>
<td>The equivalent code in the other terminology, classification or code system.</td>
</tr>
</tbody>
</table>

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5.6.2.6.3 Metadata

The following metadata hierarchy supports this reference set:

- 900000000000454005 | Foundation metadata concept |
  - 900000000000455006 | Reference set |
    - 900000000000456007 | Reference set descriptor |
    - 900000000000457008 | Attribute value type |
    - 900000000000458009 | Simple map |
      - 900000000000459000 | CTV3 simple map |
      - 900000000000460000 | SNOMED RT ID simple map |

Figure 47: Simple Map Reference Sets in the Metadata Hierarchy

5.6.2.6.4 Descriptor template and examples
The tables below show the descriptors that define examples of reference sets that follow the 900000000000496009 | Simple map reference set | pattern.

### Table 63: Refset Descriptor rows for 446608001 | ICD-O simple map reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>446608001</td>
<td>ICD-O simple map reference set</td>
<td>9000000000000500006</td>
<td>Map source concept</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>446608001</td>
<td>ICD-O simple map reference set</td>
<td>9000000000000499002</td>
<td>Scheme value</td>
</tr>
</tbody>
</table>

### Table 64: Refset Descriptor rows for 900000000000498005 | SNOMED RT ID simple map |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>9000000000000498005</td>
<td>SNOMED RT ID simple map</td>
<td>9000000000000500006</td>
<td>Map source concept</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>9000000000000498005</td>
<td>SNOMED RT ID simple map</td>
<td>9000000000000499002</td>
<td>Scheme value</td>
</tr>
</tbody>
</table>

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern \textit{id}, \textit{effectiveTime}, \textit{active}, \textit{moduleId}. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
### 5.6.2.6.5 Simple Map Refset Examples

#### Table 65: Sample content from 900000000000498005 | SNOMED RT ID simple map |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Map source concept)</th>
<th>mapTarget (Scheme value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000498005</td>
<td>100005</td>
<td>G-3000</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>101009</td>
<td>L-55535</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>102002</td>
<td>F-D5972</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>103007</td>
<td>L-37904</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>104001</td>
<td>P1-18376</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>105000</td>
<td>DD-82950</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>106004</td>
<td>T-D8602</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>107008</td>
<td>T-F1102</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>108003</td>
<td>T-49723</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>109006</td>
<td>D9-12000</td>
</tr>
</tbody>
</table>

#### Table 66: Sample content from 446608001 | ICD-O simple map reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Map source concept)</th>
<th>mapTarget (Scheme value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>446608001</td>
<td>106004</td>
<td>C76.4</td>
</tr>
<tr>
<td>446608001</td>
<td>107008</td>
<td>C58.9</td>
</tr>
<tr>
<td>446608001</td>
<td>108003</td>
<td>C49.0</td>
</tr>
<tr>
<td>446608001</td>
<td>110001</td>
<td>C64.9</td>
</tr>
</tbody>
</table>
### 5.6.2.7 Complex and Extended Map Reference Sets

#### 5.6.2.7.1 Purpose

A 447250001 | Complex map type reference set | enables representation of maps where each SNOMED CT concept may map to one or more codes in a target scheme. The type of reference set supports the general set of mapping data required to enable a target code to be selected at run-time from a number of alternate codes. It supports target code selection by accommodating the inclusion of machine readable rules and/or human readable advice. An 609331003 | Extended map type reference set | adds an additional field to allow categorization of maps.

#### 5.6.2.7.2 Data structure

A Complex map reference set is an Integer-Integer-String-String-String-Component reference set. The pattern is currently used for the map to ICD-9-CM. Its structure is as shown in the following table, with one exception - the table includes an additional field (mapCategoryId) which is not used for this type of map.

An Extended map reference set follows the same pattern but adds one additional column. It is an Integer-Integer-String-String-String-Component-Component reference set and this pattern is currently used for maps to ICD-10. Its structure is shown in the following table.

#### Table 67: Complex and Extended map reference sets - Data structures

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time $T$ is the version with the most recent effectiveTime prior to or equal to time $T$.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>reftsetld</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, a subtype of 447250001</td>
</tr>
<tr>
<td>referencedComponentld</td>
<td>SCTID</td>
<td>A reference to the SNOMED CT concept being mapped.</td>
</tr>
<tr>
<td>mapGroup</td>
<td>Integer</td>
<td>An integer, grouping a set of complex map records from which one may be selected as a target code. Where a SNOMED CT concept maps onto 'n' target codes, there will be 'n' groups, each containing one or more complex map records.</td>
</tr>
<tr>
<td>mapPriority</td>
<td>Integer</td>
<td>Within a mapGroup, the mapPriority specifies the order in which complex map records should be checked. Only the first map record meeting the run-time selection criteria will be taken as the target code within the group of alternate codes.</td>
</tr>
<tr>
<td>mapRule</td>
<td>String</td>
<td>A machine-readable rule, (evaluating to either 'true' or 'false' at run-time) that indicates whether this map record should be selected within its mapGroup.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>mapAdvice</td>
<td>String</td>
<td>Human-readable advice, that may be employed by the software vendor to give an end-user advice on selection of the appropriate target code from the alternatives presented to him within the group.</td>
</tr>
<tr>
<td>mapTarget</td>
<td>String</td>
<td>The target code in the target terminology, classification or code system.</td>
</tr>
<tr>
<td>correlationId</td>
<td>SCTID</td>
<td>A child of 447247004</td>
</tr>
</tbody>
</table>

The following additional field only applies to Extended Map Reference Sets

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>mapCategoryId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT concept in the metadata hierarchy which represents the MapCategory for the associated map member. The categories vary for different target code systems, each set of categories is represented by a subtype of 609330002</td>
</tr>
</tbody>
</table>

Values for mapGroup are allocated on a sequential basis (for each refsetId and referencedComponentId combination) during authoring starting at 1. However, distributed mapGroup are not necessarily sequential, as some mapGroups may be created and removed during a mapping process between releases. For maps where each SNOMED CT concept only maps to at most one of a group of alternate target codes, the mapGroup field are usually be set to ‘1’.

Values for mapPriority will be allocated on a sequential basis (within each map group) starting from ‘1’. For maps that do not require run-time alternatives, the mapPriority field is set to ‘1’.

The mapRule and mapAdvice fields enable run-time selection (within vendor’s software) from a number of alternative map records within a mapGroups. Where there are no alternatives maps within the release files will be empty (zero length string). Where alternative maps exist one or both of columns will be populated where relevant information is available.

Where both fields are populated, and a vendor’s system is capable of processing a machine readable rule, this should take priority over the human readable advice. Where neither field is populated, a vendor’s system should allow the end-user to select the appropriate target code from the alternates.

5.6.2.7.3 Metadata

The following metadata supports this reference set:

- 900000000000454005 | Foundation metadata concept |
  - 9000000000000455006 | Reference set |
  - 447250001 | Complex map type reference set | ...
  - 609331003 | Extended map type reference set | ...

Figure 48: Complex Map References Sets in the Metadata Hierarchy
5.6.2.7.4 Descriptor templates
The tables below examples of the descriptors for specific reference sets that follow the 447250001 | Complex map type reference set | and 609331003 | Extended map type reference set | patterns.

Table 68: Refset Descriptor rows for 447563008 | ICD-9-CM equivalence complex map reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>9000000000000500006</td>
<td>Map source concept</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>9000000000000510005</td>
<td>Map group</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>9000000000000520003</td>
<td>Map priority</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>9000000000000530008</td>
<td>Map rule</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>9000000000000540002</td>
<td>Map advice</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>9000000000000550001</td>
<td>Map target</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447563008</td>
<td>ICD-9-CM equivalence complex map reference set</td>
<td>447247004</td>
<td>SNOMED CT source code to target map code correlation value</td>
</tr>
</tbody>
</table>
Table 69: Refset Descriptor rows for 447562003 | ICD-10 complex map reference set | (Extended map type)

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>9000000000000500006</td>
<td>Map source concept</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>9000000000000501005</td>
<td>Map group</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>9000000000000502003</td>
<td>Map priority</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>9000000000000503008</td>
<td>Map rule</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>9000000000000504002</td>
<td>Map advice</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>9000000000000505001</td>
<td>Map target</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>447247004</td>
<td>SNOMED CT source code to target map code correlation value</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>609330002</td>
<td>Map category value</td>
</tr>
</tbody>
</table>

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern `id, effectiveTime, active, moduleId`. Additionally, to aid understanding, the tables above also show the `term` from one of the `descriptions` associated with each of the identified `concept`. The release file only contains the `identifier`.
5.6.2.7.5 Mapping rule specifications

The specific grammar and content of the rules for resolving complex mapping cases depends on the nature of the target code system or classification. In general, each map is accompanied by a rule which is tested against other data and can be evaluated to return one of the following values:

- **True** - in which case the map target applies;
- **False** - in which case the map target does not apply;
- **Indeterminate** - in cases where there is insufficient accessible data to determine whether the map target applies. In this case manual resolution of the map using the map advice provided will be required.

The mapping rules assume access to a number of variables, that can be bound to appropriate attributes in the vendor's system information model. These include the age and gender of the patient and information about coexisting situations (e.g. records of other disorders, procedures or events in the same patient record).

Detailed definitions of the mapping rules used forms part of individual specifications for maps to particular target code systems and classifications. This will initially be provided separately and will accompany the release of the relevant mapping files. For example, the set of rules used for mapping to *ICD-10* are currently included in a document released with those maps.

5.6.2.7.6 Extended map reference set example
<table>
<thead>
<tr>
<th>refSetId</th>
<th>referencedComponentId (Map source concept)</th>
<th>mapGroup (Map group)</th>
<th>mapPriority</th>
<th>mapRule (Map rule)</th>
<th>mapAdvice (Map advice)</th>
<th>mapTarget (Map target)</th>
<th>correlationId (SNOMED CT source code to target map code correlation value)</th>
<th>mapCategoryId (Map category value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>447562003</td>
<td>127009</td>
<td>Miscarriage with laceration of cervix</td>
<td>1</td>
<td>1</td>
<td>TRUE</td>
<td>ALWAYS O03.8</td>
<td>O03.8</td>
<td>447561005</td>
</tr>
<tr>
<td></td>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>447637006</td>
</tr>
<tr>
<td>447562003</td>
<td>127009</td>
<td>Miscarriage with laceration of cervix</td>
<td>2</td>
<td>1</td>
<td>TRUE</td>
<td>ALWAYS O08.6</td>
<td>O08.6</td>
<td>447561005</td>
</tr>
<tr>
<td></td>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>447637006</td>
</tr>
<tr>
<td>447562003</td>
<td>140004</td>
<td>Chronic pharyngitis</td>
<td>1</td>
<td>1</td>
<td>IFA 90979004</td>
<td>Chronic tonsilitis (disorder)</td>
<td>IF CHRONIC TONSILLITIS</td>
<td>CHOOSE J35.0</td>
</tr>
<tr>
<td></td>
<td>447639009</td>
<td>Map of source concept is context dependent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>447639009</td>
</tr>
<tr>
<td>mapCategoryId</td>
<td>mapTarget (Map target)</td>
<td>correlationId</td>
<td>mapAdvice (Map advice)</td>
<td>mapRule (Map rule)</td>
<td>mapPriority (Map priority)</td>
<td>mapGroup (Map group)</td>
<td>refSetId</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------</td>
<td>---------------</td>
<td>------------------------</td>
<td>-------------------</td>
<td>--------------------------</td>
<td>----------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>447639009</td>
<td>Map of source concept is context dependent</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>IF CHRONIC PHARYNGEAL CANDIDIASIS (disorder)</td>
<td>IFA 232406009 {Chronic pharyngitis}</td>
<td>2</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>CHRONIC PHARYNGEAL CANDIDIASIS</td>
<td>CHOOSE B37.8</td>
<td>3</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447639009</td>
<td>Map of source concept is context dependent</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>IF CHRONIC PHARYNGEAL CANDIDIASIS (disorder)</td>
<td>IFA 232406009 {Chronic pharyngitis}</td>
<td>2</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>CHRONIC PHARYNGEAL CANDIDIASIS</td>
<td>CHOOSE B37.8</td>
<td>3</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447639009</td>
<td>Map of source concept is context dependent</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>IF CHRONIC PHARYNGEAL CANDIDIASIS (disorder)</td>
<td>IFA 232406009 {Chronic pharyngitis}</td>
<td>2</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>CHRONIC PHARYNGEAL CANDIDIASIS</td>
<td>CHOOSE B37.8</td>
<td>3</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447639009</td>
<td>Map of source concept is context dependent</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>IF CHRONIC PHARYNGEAL CANDIDIASIS (disorder)</td>
<td>IFA 232406009 {Chronic pharyngitis}</td>
<td>2</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>CHRONIC PHARYNGEAL CANDIDIASIS</td>
<td>CHOOSE B37.8</td>
<td>3</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447639009</td>
<td>Map of source concept is context dependent</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>IF CHRONIC PHARYNGEAL CANDIDIASIS (disorder)</td>
<td>IFA 232406009 {Chronic pharyngitis}</td>
<td>2</td>
<td>140004</td>
<td></td>
</tr>
<tr>
<td>447637006</td>
<td>Map source concept is properly classified</td>
<td>447561005</td>
<td>SNOMED CT source code to target map code correlation not specified</td>
<td>CHRONIC PHARYNGEAL CANDIDIASIS</td>
<td>CHOOSE B37.8</td>
<td>3</td>
<td>140004</td>
<td></td>
</tr>
</tbody>
</table>

---

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<table>
<thead>
<tr>
<th>refSetId</th>
<th>referencedComponentId (Map source concept)</th>
<th>mapGroup (Map group)</th>
<th>mapPriority (Map priority)</th>
<th>mapRule (Map rule)</th>
<th>mapAdvice (Map advice)</th>
<th>mapTarget (Map target)</th>
<th>correlationId (SNOMED CT source code to target map code correlation value)</th>
<th>mapCategoryId (Map category value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>177007</td>
<td>Poisoning by sawfly larvae</td>
<td>2</td>
<td>1</td>
<td>TRUE</td>
<td>ALWAYS X25</td>
<td>POSSIBLE REQUIREMENT FOR PLACE OF OCCURRENCE</td>
</tr>
<tr>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>181007</td>
<td>Hemorrhagic bronchopneumonia</td>
<td>1</td>
<td>1</td>
<td>TRUE</td>
<td>ALWAYS J18.0</td>
<td>J18.0</td>
</tr>
<tr>
<td>447562003</td>
<td>ICD-10 complex map reference set</td>
<td>183005</td>
<td>Autoimmune pancytopenia</td>
<td>1</td>
<td>1</td>
<td>TRUE</td>
<td>ALWAYS D61.8</td>
<td>D61.8</td>
</tr>
</tbody>
</table>
5.6.2.8 Language Reference Set

5.6.2.8.1 Purpose

A 900000000000506000 | Language type reference set | supports the representation of language and dialects preferences for the use of particular descriptions. The most common use case for this type of reference set is to specify the acceptable and preferred terms for use within a particular country or region. However, the same type of reference set can also be used to represent preferences for use of descriptions in a more specific context such as a clinical specialty, organisation or department.

5.6.2.8.2 Data structure

A Language reference set is a Component reference set that is used to indicate which descriptions contain terms that are acceptable or preferred in a particular language or dialect. Its structure is shown in the following table.

Table 71: Language reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time T is the version with the most recent effectiveTime prior to or equal to time T.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, a subtype of 900000000000506000</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>The identifier of a description included in the language reference set.</td>
</tr>
<tr>
<td>acceptabilityId</td>
<td>SCTID</td>
<td>A subtype of 900000000000511003</td>
</tr>
</tbody>
</table>

In a Language reference set:

- No more than one description of a specific description type associated with a single concept may have the acceptabilityId value 900000000000548007 | Preferred |.
- At least one description of description typesynonym associated with each concept should have the acceptabilityId value 900000000000548007 | Preferred |. This is the preferred term for that concept in the specified language or dialect.

5.6.2.8.3 Metadata

The following metadata supports this reference set:

- 900000000000454005 | Foundation metadata concept |
- 900000000000455006 | Reference set |
- 900000000000456007 | Reference set descriptor |
- 900000000000480006 | Attribute value type |
- 900000000000496009 | Simple map |
- 900000000000506000 | Language type |
- 900000000000507009 | English |
  - 900000000000508004 | GB English |
  - 900000000000509007 | US English |

Figure 49: Language References Sets in the Metadata Hierarchy

The immediate children of | Language type| will be languages. This level may be used to represent the “correct” language, where a language authority exists. In most cases, however, this level is likely to be empty.

5.6.2.8.4 Descriptor template
The table below shows an example of the descriptor for a specific *reference sets* that follows the 900000000000506000 | Language type reference set | pattern.

**Table 72: Refset Descriptor rows for 900000000000508004 | GB English |.**

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000456007</td>
<td>900000000000508004</td>
<td>GB English</td>
<td>900000000000510002</td>
<td>Description in dialect</td>
</tr>
<tr>
<td>900000000000456007</td>
<td>900000000000508004</td>
<td>GB English</td>
<td>900000000000511003</td>
<td>Acceptability</td>
</tr>
</tbody>
</table>

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern *id, effectiveTime, active, moduleId*. Additionally, to aid understanding, the tables above also show the *term* from one of the *descriptions* associated with each of the identified *concept*. The release file only contains the *identifier*. 
### 5.6.2.8.5 Examples of language reference sets

#### Table 73: Sample content from 900000000000509007 | US English |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Description in dialect)</th>
<th>acceptabilityId (Acceptability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000509007</td>
<td>42969009</td>
<td>Cauterization of skin (id:71693012)</td>
</tr>
<tr>
<td>900000000000509007</td>
<td>42969009</td>
<td>Fulguration of subcutaneous tissue (id:71695017)</td>
</tr>
<tr>
<td>900000000000509007</td>
<td>80146002</td>
<td>Appendectomy (id:132967011)</td>
</tr>
<tr>
<td>900000000000509007</td>
<td>80146002</td>
<td>Excision of appendix (id:132972019)</td>
</tr>
<tr>
<td>900000000000509007</td>
<td>271737000</td>
<td>Anemia (id:406636013)</td>
</tr>
<tr>
<td>900000000000509007</td>
<td>271737000</td>
<td>Absolute anemia (id:406640016)</td>
</tr>
</tbody>
</table>

#### Table 74: Sample content from 900000000000508004 | GB English |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Description in dialect)</th>
<th>acceptabilityId (Acceptability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000508004</td>
<td>42969009</td>
<td>Cauterisation of skin (id:493493018)</td>
</tr>
<tr>
<td>900000000000508004</td>
<td>42969009</td>
<td>Fulguration of subcutaneous tissue (id:71695017)</td>
</tr>
<tr>
<td>900000000000508004</td>
<td>80146002</td>
<td>Appendicectomy (id:132973012)</td>
</tr>
<tr>
<td>900000000000508004</td>
<td>80146002</td>
<td>Excision of appendix (id:132972019)</td>
</tr>
<tr>
<td>900000000000508004</td>
<td>271737000</td>
<td>Anaemia (id:406641017)</td>
</tr>
</tbody>
</table>

In the above examples, Excision of appendix is acceptable in both US and GB English. However, Appendectomy is preferred in US English and Appendicectomy is preferred in GB English.

**Note:** Any description which is not referenced by an active row in the relevant language reference set is regarded as unacceptable (i.e. not a valid synonym in the language or dialect).
5.6.2.9 Query Specification Reference Set

5.6.2.9.1 Purpose

A 900000000000512005 | Query specification type reference set | allows a serialised query to represent the membership of a subset of SNOMED CT components. A query contained in the reference set is run against the content of SNOMED CT to produce a subset of concepts, descriptions or relationships. The query is referred to an intensional definition of the subset. It can be run against future releases of SNOMED CT to generate an updated set of subset members.

The members of the resulting subset may also be represented in an enumerated form as a Simple reference set. An enumerated representation of a subset is referred to as an extensional definition.

5.6.2.9.2 Data structure

A Query specification reference set is a String reference set containing queries that represent intensional definitions of subsets of components. The result of running the query is an extensional representation of the subset of components which can be represented as a Simple reference set. Its structure is shown in the following table.

Table 75: Query specification reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time T is the version with the most recent effectiveTime prior to or equal to time T.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
</tbody>
</table>
### Purpose

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to a subtype of 900000000000512005</td>
</tr>
<tr>
<td>referencedComponentld</td>
<td>SCTID</td>
<td>The identifier (refsetld) of the reference set for which members are to be generated.</td>
</tr>
<tr>
<td>query</td>
<td>String</td>
<td>The serialised query that can be used to (re-)generate the reference set members. A standard syntax for use in these queries is currently under development and is due for publication in late 2014.</td>
</tr>
</tbody>
</table>

### 5.6.2.9.3 Metadata

The following metadata in the "Foundation metadata concept" hierarchy supports this reference set:

- 900000000000454005 | Foundation metadata concept |
  - 900000000000455006 | Reference set |
    - 900000000000512005 | Query specification type |
    - 900000000000513000 | Simple query specification |

Figure 50: Hierarchy of Foundation metadata concept

### 5.6.2.9.4 Descriptor template
The table below shows the descriptor that defines the structure of the 900000000000512005 | Query specification type reference set | pattern.

Table 76: Descriptor Template for Query Specification Reference Sets

<table>
<thead>
<tr>
<th>referencedComponentId</th>
<th>attributeDescription</th>
<th>attributeType</th>
<th>attributeOrder</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000512005</td>
<td>Generated reference set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900000000000515007</td>
<td>Query</td>
<td>900000000000461009</td>
<td>Concept type component</td>
</tr>
<tr>
<td>900000000000456007</td>
<td>Reference set descriptor</td>
<td>900000000000465000</td>
<td>String</td>
</tr>
</tbody>
</table>

Note: The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.9.5 Example usage

In the example below, "serialised query 1" is a text string that can be used to generate members for Reference set 1, which is a simple member reference set (without any additional fields within its member records).

Table 77: Example rows from Query Specification Reference Set

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>query</th>
</tr>
</thead>
</table>
| | Target reference set |Serialized text of the query ...

5.6.2.9.6 Query language specification

The specification of the query language has yet to be defined / selected, but it should be capable of:

- Selecting concepts using primary fields, subsumption testing, relationships, relationship groups, set operators (union, intersection, excludes), and lexical query;
- Selecting descriptions, relationships and reference sets using similar mechanisms;
- Calculation of values for the reference set's extended fields. Identifying the version of the syntax and any language syntax variations.
- Queries that support definitions for terminologies other than SNOMED CT should also be supported. For example, queries to link or include codes in ICD-10, ICD-11, ICPC and LOINC.

Note: During 2014 work is underway to develop and pilot a standard approach to representation of queries including queries for generation of subset of SNOMED CT concepts.

5.6.2.10 Annotation Reference Set

5.6.2.10.1 Purpose

An 900000000000516008 | Annotation type reference set | allows text strings to be associated with components for any specified purpose.

5.6.2.10.2 Data structure

An annotation reference set String reference set used to apply text annotations to selected SNOMED CT components.

Table 78: Annotation reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The current version of this reference set member at time $T$ is the version with the most recent effectiveTime prior to or equal to time $T$.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In this case, set to 900000000000516008</td>
</tr>
<tr>
<td>referencedComponentld</td>
<td>SCTID</td>
<td>The identifier of the component to be annotated.</td>
</tr>
<tr>
<td>annotation</td>
<td>String</td>
<td>The text annotation to attach to the component identified by referencedComponentld.</td>
</tr>
</tbody>
</table>

5.6.2.10.3 Metadata

The following metadata in supports this reference set:
- 900000000000454005 | Foundation metadata concept |
  - 900000000000455006 | Reference set |
    - 9000000000000516008 | Annotation type |
    - 900000000000517004 | Associated image |

Figure 51: Annotation References Sets in the Metadata Hierarchy

5.6.2.10.4 Descriptor template
The tables below show the descriptors that define the structure of the 900000000000516008 | Annotation type reference set | pattern and examples of the descriptors for specific reference sets that follow this pattern.

### Table 79: Descriptor Template for Annotation Reference Sets

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>attributeDescription</th>
<th>attributeType</th>
<th>attributeOrder</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000461009</td>
<td>9000000000000516008</td>
<td>Annotation type</td>
<td>9000000000000518009</td>
<td>900000000000456007</td>
</tr>
<tr>
<td>9000000000000461009</td>
<td>9000000000000516008</td>
<td>Annotated component</td>
<td>9000000000000519001</td>
<td>900000000000456007</td>
</tr>
</tbody>
</table>

The attributeType for the Annotation field can be any descendant of the "string" concept in the metadata hierarchy. This hierarchy is described in more detail under the "Reference set descriptor" section.

The table below holds the Descriptor for the "Associated image" annotation reference set, which allows URLs to be associated with concepts:

### Table 80: Descriptor for 900000000000517004 | Associated image reference set |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>attributeDescription</th>
<th>attributeType</th>
<th>attributeOrder</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000461009</td>
<td>9000000000000517004</td>
<td>Associated image</td>
<td>9000000000000519001</td>
<td>900000000000456007</td>
</tr>
<tr>
<td>9000000000000461009</td>
<td>9000000000000517004</td>
<td>Image</td>
<td>9000000000000465000</td>
<td>900000000000456007</td>
</tr>
</tbody>
</table>

Note that in the table above, the URL concept is a descendant of the "string" concept in the metadata.

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.10.5 Annotation reference set example

As no annotation reference sets are included in the International Release, these sample rows are for illustration only.

Table 81: Example of "Associated image" Annotation Reference Set

<table>
<thead>
<tr>
<th>refsetld</th>
<th>referencedComponentId</th>
<th>Annotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000517004</td>
<td>80891009</td>
<td>Heart structure</td>
</tr>
<tr>
<td>900000000000517004</td>
<td>86174004</td>
<td>Laparoscope</td>
</tr>
</tbody>
</table>

In the above example, the two URLs have been used to annotate two SNOMED CT concepts with images on the web. It is not recommended that this mechanism be used to annotate concepts with text that may require translation to other languages. Instead, such text should be included under an appropriate description type within the Description file.

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.

5.6.2.11 Association Reference Set

5.6.2.11.1 Purpose

An 900000000000521006 | Association type reference set | represents a set of unordered associations of a particular type between components.

5.6.2.11.2 Data structure

An Association reference set is a Component reference set used to represent associations between component. Its structure is shown in the following table.

Table 82: Association reference Set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time $T$ is the version with the most recent effectiveTime prior to or equal to time $T$.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active = 1 (true) the reference set member is part of the current version of the set, if active = 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleid</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to a subtype of 900000000000521006</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>The identifier of the source component of the association.</td>
</tr>
<tr>
<td>targetComponentId</td>
<td>SCTID</td>
<td>The identifier of the target component of the association.</td>
</tr>
</tbody>
</table>

5.6.2.11.3 Metadata

The following metadata in the "Foundation metadata concept hierarchy" supports this reference set:

- 900000000000455006 | Reference set | |
  - 900000000000521006 | Association type | |
    - 900000000000522004 | Historical association | |
      - 900000000000523009 | POSSIBLY EQUIVALENT TO association reference set | |
      - 900000000000524003 | MOVED TO association reference set | |
      - 900000000000525002 | MOVED FROM association reference set | |
      - 900000000000526001 | REPLACED BY association reference set | |
      - 900000000000527005 | SAME AS association reference set | |
      - 900000000000528000 | WAS A association reference set | |
      - 900000000000529008 | SIMILAR TO association reference set | |
      - 900000000000530003 | ALTERNATIVE association reference set | |
      - 900000000000531004 | REFERENCES TO concept association reference set | |

*Figure 52: Association Reference Sets in the Metadata Hierarchy*
5.6.2.11.4 Notes on usage

Each member of a | Historical association | reference set represents a Reference from an inactive component to other equivalent or related components that were current in the Release Version in which that component was inactivated.

Each | Historical association | reference set holds Relationships of a different nature between the components. The | Historical association | reference sets contains associations:

- from each inactive description to one or more other Descriptions that are current in the release Version in which the description was inactivated;
- from each inactive reference set for which there is a current replacement to the replacement reference set;
- from an inactive description to a concept that is current in the Release Version in which the description was inactivated, and which is correctly described by the Term of the inactive description;
- From each inactive concept to one or more concepts that replace it.

The component identified by the targetComponentId must be an instance of the same class of component as the component identified by the referencedComponentId for all | Historical association | reference sets apart from the | REFERS TO concept association reference set |.

Within the | REFERS TO concept association reference set |, the referenced ComponentId field must be a description and the targetComponentId must be a concept.

The targetComponentId is used differently in the |MOVED TO association reference set |. In this case, the targetComponentId does not refer directly to a replacement component, but rather to the namespace to which the component was moved to. The targetComponentId actually refers to the concept that represents the namespace. This approach is used since the organisation sourcing the component may not always be able to determine the precise reference that is applicable in the receiving organisation (namespace). Thus the responsibility for these references lies with the new responsible (receiving) organisation.

5.6.2.11.5 Descriptor template and examples
The tables below show examples of the descriptors for specific *reference sets* that follow the 900000000000521006 | Association type reference set | pattern.

### Table 83: Refset Descriptor rows for 900000000000527005 | SAME AS association reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000460005</td>
<td>9000000000000527005</td>
<td>SAME AS association reference set</td>
<td>900000000000532006</td>
<td>Component type</td>
</tr>
<tr>
<td>9000000000000460005</td>
<td>9000000000000527005</td>
<td>SAME AS association reference set</td>
<td>900000000000533001</td>
<td>Component type</td>
</tr>
</tbody>
</table>

### Table 84: Refset Descriptor rows for 900000000000531004 | REFERS TO concept association reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000460005</td>
<td>9000000000000531004</td>
<td>REFERS TO concept association reference set</td>
<td>900000000000532006</td>
<td>Component type</td>
</tr>
<tr>
<td>9000000000000460005</td>
<td>9000000000000531004</td>
<td>REFERS TO concept association reference set</td>
<td>900000000000533001</td>
<td>Component type</td>
</tr>
</tbody>
</table>

**Note:** The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern *id, effectiveTime, active, moduleId*. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.11.6 Association reference set example

The following table holds example entries for the reference set.

Table 85: Sample content from 900000000000526001 | REPLACED BY association reference set |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Association source component)</th>
<th>targetComponentId (Association target component)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000526001</td>
<td>100005</td>
<td>SNOMED RT Concept</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>212002</td>
<td>Salmonella III arizonae 53:k:z</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>225005</td>
<td>Special care of patient with contagious disease</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>244003</td>
<td>Evans and Lloyd-Thomas syndrome</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>278009</td>
<td>Epidural injection of neurolytic substance, lumbar</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>558000</td>
<td>Other disorder of the neurohypophysis, NEC</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>659001</td>
<td>Peptostreptococcus anaerobius</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>696005</td>
<td>Chronobiologic disorder</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>700002</td>
<td>Salmonella III arizonae 50:z4,z23,z32:--</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>822000</td>
<td>Salmonella arizonae 53:z4,z23:--</td>
</tr>
</tbody>
</table>

Note: The tables above omit the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.12 Module Dependency Reference Set

5.6.2.12.1 Purpose

The 900000000000534007 | Module dependency reference set | represents dependencies between different SNOMED CT release modules. In each case, the dependency indicates which version of each particular module a given version of the dependent module requires.

5.6.2.12.2 Data structure

The Module dependency reference set is a String-String reference set which is used to represent dependencies between modules, taking account of module versioning. Its structure is shown in the following table.

Table 86: Module dependency reference set - Data Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time ( T ) is the version with the most recent effectiveTime prior to or equal to time ( T ).</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active( = 1 ) (true) the reference set member is part of the current version of the set, if active( = 0 ) (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 900000000000443000</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to 9000000000000534007</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>The identifier of a target module on which the dependent module (identified by moduleId) depends. Thus must be a subtype of 9000000000000443000</td>
</tr>
<tr>
<td>sourceEffectiveTime</td>
<td>Time</td>
<td>The effective time of the dependent source module (identified by moduleId). This specifies a version of that module, consisting of all components that have the same moduleId as this refset member in their states as at the specified targetEffectiveTime.</td>
</tr>
<tr>
<td>targetEffectiveTime</td>
<td>Time</td>
<td>The effective time of the target module required to satisfy the dependency (identified by referencedComponentId). This specifies a version of that module, consisting of all components with the moduleId specified by referencedComponentId in their states as at the specified targetEffectiveTime.</td>
</tr>
</tbody>
</table>

### 5.6.2.12.3 Notes on usage

Module version dependencies are represented using a single 9000000000000534007 | Module dependency reference set |. Thus all module dependency rows have the same refsetId (9000000000000534007).

It is the responsibility of the organisation owning and maintaining a dependent module to identify all modules on which it depends. They do this by adding rows to the 9000000000000534007 | Module dependency reference set | within the dependent module. Because these added members must be in the dependent module, the moduleId of the reference set member record is also the identifier of the dependent (source) module. The target module on which the source module depends is identified by the referencedComponentId.

A module version may depend on one or more other module versions, and many module versions may have a dependency on a single module version. Cyclic module version dependencies are not allowed. If module-A depends on module-B, then module-B cannot depend on module-A.

Dependencies are not transitive and this means that dependencies cannot be inferred from a chain of dependencies. If module-A depends on module-B and module-B depends on module-C, the dependency of module-A on module-C must still be stated explicitly.

Any release should consist of a set of module versions that are certified as being compatible. Each release should also identify other module versions that it is dependent on even when these are outside the scope of the release. For example, the dependencies of modules in an Extension on the International Release must be stated.

Dependencies are specified between module versions, not just dependencies between modules. Therefore, it is possible to specify a dependency from a module released on one date to an earlier version of another module. The version of the dependent module is specified by the sourceEffectiveTime and the version of the module on which it depends is specified by the targetEffectiveTime.

>Note: Current practice assumes the refset.id column contains the same identifier for all versions of the dependencies between the same pair of modules. This approach means that at any given time...
only one version of each module has effective dependencies. Therefore, to review the dependencies of an earlier version, a snapshot for an earlier time must be checked. An alternative approach has been suggested by some people in which a new identifier is allocated to each dependency of each module. This would then mean that all past dependencies would be visible in a snapshot view. It would also mean that it would be possible release updated dependencies for an existing module version while also releasing more up-to-date versions of the same module with different dependencies. This added flexibility comes at the price of additional complexity and for the time-being the International Release continues to use the simpler approach in which each new version of a dependency supersedes the dependency between earlier versions of the same pair of modules.

5.6.2.12.4 Metadata

The following metadata in the "Foundation metadata concept hierarchy supports this reference set:

- 9000000000000454005 | Foundation metadata concept |
  - 9000000000004550006 | Reference set |
    - 900000000000534007 | Module dependency |

Figure 53: Module Dependency Reference Set in the Metadata Hierarchy

Each component within a SNOMED CT release references a moduleId. This is the module that the component is currently mastered in (from the effectiveTime held on the component record). A module is simply a collection of SNOMED CT components that are maintained as a unit by a single organisation. It is the organisation's responsibility to organise the components in each extension that it is responsible for into one or more modules, in a way that best fits its business needs.

A module is modelled by a descendant of 900000000000443000 | Module | in the metadata hierarchy. The 9000000000000443000 | Module | sub-hierarchy is organised by a maintaining organisation into a number of groups. For example, all modules maintained by IHTSDO will be children of 9000000000000445007 | IHTSDO maintained module |. The 900000000000443000 | Module | sub-hierarchy models modules maintained by each organisation and does NOT model module dependencies. Instead, module dependencies are modelled using the 900000000000534007 | Module dependency reference set |.

At the point of release, if any component within a module has changed, then a new row will be added to 900000000000534007 | Module dependency reference set | for the module’s concept, with the effectiveTime set to the date of the new release, irrespective of whether the other fields in the module concept record itself have changed. The updated Module | concept record identifies that some components within the module have been updated in this release. Where no components within a module have been updated, then a new module record will not be added and the module’s effectiveTime field will not change from the previous release.

Each component will be in one, and only one component. The module that a component is mastered in may change over time, and when this happens, the component’s moduleId field will be updated (in the usual way by appending a row for the component).

Each module will be in one and only one extension. Modules will not straddle extensions. The extension that a module resides in is defined by the SCTID of the module. A module may not move from one extension to another over time. If the components within a module are to be moved to another extension, then a new module must be created within the destination extension to host the components that are to be transferred.

There may be more than one module in an extension.

5.6.2.12.5 Descriptor

The table below shows the descriptor that defines the structure of the 900000000000534007 | Module dependency reference set |.
Table 87: Refset Descriptor rows for 900000000000534007 | Module dependency |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>attributeDescription</th>
<th>attributeType</th>
<th>attributeOrder</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000000000000456007</td>
<td>900000000000534007</td>
<td>900000000000535008</td>
<td>Referenced component</td>
<td>0</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>900000000000534007</td>
<td>900000000000536009</td>
<td>Source effective time</td>
<td>1</td>
</tr>
<tr>
<td>9000000000000456007</td>
<td>900000000000534007</td>
<td>900000000000537000</td>
<td>Target effective time</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: The table above omits the initial four columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active, moduleId. Additionally, to aid understanding, the table above also shows the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.

5.6.2.12.6 Module dependency reference set example

The table below holds example entries for the 900000000000534007 | Module dependency reference set | in a snapshot view of the January 2014 SNOMED CT International Release.

This SNOMED CT International Release contains three modules:

- 900000000000012004 | SNOMED CT model component | which has no dependencies;
- 900000000000207008 | SNOMED CT core | which depends on the 900000000000012004 | SNOMED CT model component |; and
- 449080006 | SNOMED CT to ICD-10 rule-based mapping module | which depends on both the other modules.

In this case all the 2014-01-31 modules depend on 2014-01-31 versions of the other modules. However, in some case a module may depend on an earlier version of another model (e.g. an extension module may be releases after the SNOMED CT International Release to which it applies).

Dependencies are not transitive. The fact that 449080006 | SNOMED CT to ICD-10 rule-based mapping module | is dependent on 900000000000207008 | SNOMED CT core | may seem to imply a dependency on 900000000000012004 | SNOMED CT model component |. However, in practice all dependencies must be explicitly specified, not just immediate dependencies.
Table 88: Sample content from 900000000000534007 | Module dependency |.

<table>
<thead>
<tr>
<th>moduleId</th>
<th>refsetId</th>
<th>referencedComponentId (Dependency target)</th>
<th>sourceEffectiveTime (Source effective time)</th>
<th>targetEffectiveTime (Target effective time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90000000000207008</td>
<td>900000000000534007</td>
<td>90000000000012004</td>
<td>20140131</td>
<td>20140131</td>
</tr>
<tr>
<td>449080006</td>
<td>9000000000000534007</td>
<td>90000000000012004</td>
<td>20140131</td>
<td>20140131</td>
</tr>
<tr>
<td>449080006</td>
<td>9000000000000534007</td>
<td>90000000000207008</td>
<td>20140131</td>
<td>20140131</td>
</tr>
</tbody>
</table>

Note: The tables above omit the initial three columns of data present in the release file. These follow the standards versioning pattern id, effectiveTime, active. Additionally, to aid understanding, the tables above also show the term from one of the descriptions associated with each of the identified concept. The release file only contains the identifier.
5.6.2.13 Description Format Reference Set

5.6.2.13.1 Purpose

The 9000000000000538005 | Description format reference set | specifies the text format and maximum length of each supported description type. This permits additional description types to be specified in future in addition to the three existing description types (synonym, fully specified name and textual definition).

5.6.2.13.2 Data structure

The 9000000000000538005 | Description format reference set | is a C-I (component - integer) reference set which is used to specify the length and format of the terms in descriptions of this description type. Its structure is shown in the following table.

Table 89: Description format reference set - Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A 128 bit unsigned integer, uniquely identifying this reference set member. Different versions of a reference set member share the same id but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The inclusive date or time at which this version of the identified reference set member became the current version. The current version of this reference set member at time T is the version with the most recent effectiveTime prior to or equal to time T.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>The state of the identified reference set member as at the specified effectiveTime. If active= 1 (true) the reference set member is part of the current version of the set, if active= 0 (false) the reference set member is not part of the current version of the set.</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>Identifies the SNOMED CT module that contains this reference set member as at the specified effectiveTime. The value must be a subtype of 9000000000000443000</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>Identifies the reference set to which this reference set member belongs. In this case, set to 9000000000000538005</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>A reference to the subtype of 900000000000446008</td>
</tr>
<tr>
<td>descriptionFormat</td>
<td>SCTID</td>
<td>A reference to a subtype of 900000000000539002</td>
</tr>
<tr>
<td>descriptionLength</td>
<td>Integer</td>
<td>The maximum length in bytes of the terms in descriptions of this description type.</td>
</tr>
</tbody>
</table>

5.6.2.13.3 Metadata

The following metadata supports the description format reference set:

- 900000000000454005 | Foundation metadata concept |
  - 900000000000455006 | Reference set |
    - 900000000000538005 | Description format |

Figure 54: Description Format Reference Sets in the Metadata Hierarchy

5.6.2.13.4 Descriptor
The table below shows the descriptor that defines the structure of the | Description format reference set |

Table 90: Refset Descriptor rows for | Description format |

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Referenced component)</th>
<th>attributeDescription (Attribute description)</th>
<th>attributeType (Attribute type)</th>
<th>attributeOrder (Attribute order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000538005</td>
<td>9000000000000461009</td>
<td>9000000000000462002</td>
<td>9000000000000461009</td>
<td>0</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Description format</td>
<td>Description type component</td>
<td>Concept type component</td>
<td></td>
</tr>
<tr>
<td>900000000000538005</td>
<td>9000000000000461009</td>
<td>9000000000000539002</td>
<td>9000000000000461009</td>
<td>1</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Description format</td>
<td>Description format</td>
<td>Concept type component</td>
<td></td>
</tr>
<tr>
<td>900000000000538005</td>
<td>9000000000000461009</td>
<td>9000000000000544009</td>
<td>9000000000000478000</td>
<td>2</td>
</tr>
<tr>
<td>Reference set descriptor</td>
<td>Description format</td>
<td>Description length</td>
<td>Unsigned integer</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The table above omits the initial four columns of data present in the release file. These follow the standards versioning pattern *id, effectiveTime, active, moduleId*. Additionally, to aid understanding, the table above also shows the *term* from one of the *descriptions* associated with each of the identified *concept*. The release file only contains the *identifier*. 
5.6.2.13.5 Description format reference set example

This example holds the all the members of the 90000000000000538005 | Description format reference set | in the SNOMED CT International Release for July 2014. Other members may added to future versions of the International Release if new description types are introduced. Owners of Extensions that support additional description types must also add members to the 90000000000000538005 | Description format reference set |.

Table 91: Sample content from 90000000000000538005 | Description format |.

<table>
<thead>
<tr>
<th>refsetId</th>
<th>referencedComponentId (Description type component)</th>
<th>descriptionFormat (Description format)</th>
<th>descriptionLength (Description length)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90000000000000538005</td>
<td>90000000000000003001</td>
<td>9000000000000540000</td>
<td>255</td>
</tr>
<tr>
<td>90000000000000538005</td>
<td>900000000000013009</td>
<td>9000000000000540000</td>
<td>255</td>
</tr>
<tr>
<td>90000000000000538005</td>
<td>9000000000000550004</td>
<td>9000000000000540000</td>
<td>4096</td>
</tr>
</tbody>
</table>

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Chapter 6

6 Concept Model Guide

This part of the guide explains the *SNOMED CT Concept Model*. This is the model used to specify logical definitions of *SNOMED CT concepts*. It is based on a combination of formal logic and a set of editorial rules that determined the permitted sets of *attributes* and values that may applied to particular types of concepts.

6.1 Essential Features of the Concept Model

This section describes key features of the *Concept Model* that underpin the definitions of all *SNOMED CT concepts*.

6.1.1 Root and top-level Concepts

6.1.1.1 The Root Concept

The *Concept file* includes a special concept referred to as the *Root Concept*. It is the "root" of the main hierarchy that contain all the *Concepts* in *SNOMED CT*.

All other *Concepts* are descended from this "root" concept via at least one series of *Relationships* of the *Relationship Type | is a |* (i.e. all other *Concepts* are regarded as subclasses of this *Concept*).

The *Root Concept* Code is 138875005 and is named | SNOMED CT Concept |.

6.1.1.1.2 Release information in the root Concept

All other *SNOMED CT Concepts* are *subtypes* of the root *concept*.

Unlike other *SNOMED CT Concepts*, the root *concept* is not a *subtype* of any other *concept*.

6.1.1.2 Release information in the root Concept

The root *Concept* has a current *Synonym* that contains information about the release. The *Synonyms*, representing earlier releases, are distributed as *Inactive Descriptions*. The release information is represented in the term text of the *Synonym* as indicated in Table 92.

Table 92: Representation of release information in the root Concept

<table>
<thead>
<tr>
<th>Example</th>
<th><em>SNOMED Clinical Terms</em> version: 20020131 [R] (first release)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stylized form</td>
<td><em>SNOMED Clinical Terms</em> version: yyyymmdd [status] (description)</td>
</tr>
<tr>
<td>yyyyymmdd</td>
<td>The release date in <em>ISO</em> format.</td>
</tr>
<tr>
<td>Status</td>
<td>R (release), D (developmental) or E (evaluation).</td>
</tr>
<tr>
<td>Description</td>
<td>An optional free text <em>description</em> of the release.</td>
</tr>
</tbody>
</table>
6.1.1.2 Top-level Concepts

Concepts that are directly related to the Root Concept by a single Relationship of the Relationship Type | is a | are referred to as "Top Level Concepts". All other concepts are descended from at least one Top Level Concept via at least one series of Relationships of the Relationship Type | is a | (i.e. all other concepts represent subclasses of the meaning of at least one Top Level Concept).

Many Top-level Concepts are intended to represent things outside of SNOMED CT (including processes, events, and material entities) in the real world. These include:

Table 93: Top Level Concepts

| Clinical finding | Physical force |
| Procedure | Event |
| Observable entity | Environment or geographical location |
| Body structure | Social context |
| Organism | Situation with explicit context |
| Substance | Staging and scales |
| Pharmaceutical / biologic product | Physical object |
| Specimen | Qualifier value |
| Special concept | Record artifact |
| SNOMED CT Model Component |

6.1.1.2.1 Representation of top-level Concepts

Awareness of the top-level Concepts is likely to be particularly important when developing technical implementations.

A top-level Concept can be identified by the fact that it has a single subtype relationship referring to the Root Concept. However, to minimise processing requirements the top-level Concepts have designated Concept Identifiers that are documented in this guide as Important Concept Identifiers.

6.1.1.3 Top Level Metadata Concepts

Metadata codes represent structural information about the terminology itself. The Top Level Metadata Concepts represent broad groups of metadata.

Table 94: Top Level Metadata

| Core metadata concept |
| Foundation metadata concept |
| Linkage concept |
| Namespace concept |

6.1.2 Subtype Relationships

6.1.2.1 Role of subtype Relationships

Subtype Relationships provide the main semantic hierarchy that relates Concepts to one another.

All Active Concepts, except the root Concept, have subtype Relationships with one or more Concepts. Each of these Relationships indicates that a Concept is a subtype of another Concept.
6.1.2.2 Representation of Subtype Relationships

Subtype Relationships are expressed in the same way as all other SNOMED CT Relationships. They are identifiable by their RelationshipType, which refers to a Concept with the Fully Specified Name | is a |.

The subtype Relationship Concept has a designated Concept Identifier, which is documented in this guide as an Important Concept Identifier.

6.1.2.3 Subtype Relationships and the Subtype Hierarchy

Subtype Relationships represent the subtype hierarchy of SNOMED CT. This is illustrated here using a small sample set of concepts and Relationships listed in Table 95.

Table 95: Subtype Relationships Example

<table>
<thead>
<tr>
<th>Source</th>
<th>Relationship Type</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>bacterial pneumonia</td>
<td>is a</td>
<td>infective pneumonia</td>
</tr>
<tr>
<td>bacterial pneumonia</td>
<td>is a</td>
<td>bacterial infectious disease</td>
</tr>
<tr>
<td>infective pneumonia</td>
<td>is a</td>
<td>infectious disease</td>
</tr>
<tr>
<td>infective pneumonia</td>
<td>is a</td>
<td>pneumonia</td>
</tr>
<tr>
<td>pneumonia</td>
<td>is a</td>
<td>disease of lung</td>
</tr>
<tr>
<td>disease of lung</td>
<td>is a</td>
<td>disease of respiratory system</td>
</tr>
<tr>
<td>disease of respiratory system</td>
<td>is a</td>
<td>disease</td>
</tr>
<tr>
<td>bacterial infectious disease</td>
<td>is a</td>
<td>infectious disease</td>
</tr>
<tr>
<td>infectious disease</td>
<td>is a</td>
<td>disease</td>
</tr>
<tr>
<td>disease</td>
<td>is a</td>
<td>SNOMED CT Concept</td>
</tr>
</tbody>
</table>

Only the most proximate | is a | relationships are represented in the distribution files. These Relationships are shown by the blue lines in Figure 55. However, a Concept is a subtype of any concept to which it has a direct or indirect | is a | Relationship.

- Thus the Concept | bacterial pneumonia | is a subtype of all the other concepts shown in the diagram.

Example:

| Bacterial pneumonia | is a subtype of | pneumonia | because it is a subtype of | infective pneumonia | which is a subtype of | pneumonia. |

---

8 Only a small sample of concepts and relationships have been included to produce a simple illustration. Some concept have been omitted and direct relationships have been included where in the release data the relationships pass via additional intermediate concepts.
Figure 55: Graphical view of the Supertypes of | bacterial pneumonia |

The number of links in the chain of | is a | Relationships between two Concepts does not alter the logical meaning of the relationship between them. The number of | is a | Relationships between two Concepts may change between releases of SNOMED CT as a result of the addition of an intermediate Concept. This does not alter the semantic relationship between them.

Some technical implementation issues are affected by whether a pair of Concepts is linked by a single subtype Relationship or by a sequence of several subtype Relationships. In this guide, the following terms are used where this distinction is technically significant:

A given Concept (Concept-x) may have:

- **Subtype children** - Concepts with a subtype Relationship referring to Concept-x:
  - | bacterial pneumonia | is a subtype child of:
    - | bacterial infectious disease |
    - | infective pneumonia |

- **Supertype parents** - Concepts referred to by a subtype Relationship from Concept-x:
  - | infectious disease | is a supertype parent of:
    - | bacterial infectious disease |
    - | infective pneumonia |

- **Subtype descendants** - Concepts with subtype Relationships that refer to other Concepts that are either child or subtype descendants of Concept-x:
  - | bacterial pneumonia | is a subtype descendant of:
• All other Concepts shown in the example.

• Supertype ancestors - Concepts referred to by subtype Relationships from other Concepts that are either parent or supertype ancestors of Concept-x:
  • | disease | is an supertype ancestor of:
    • All other Concepts shown in the example, except for | SNOMED CT Concept |.

• | bacterial pneumonia |
  • | bacterial pneumonia | | is a | | infective pneumonia |
  • | infective pneumonia | | is a | | infectious disease |
    • | infectious disease | | is a | | disease |
    • | disease | | is a | | SNOMED CT Concept |

  • | infective pneumonia | | is a | | pneumonia |
  • | pneumonia | | is a | | disease of lung |
    • | disease of lung | | is a | | disease of respiratory system |
    • | disease of respiratory system | | is a | | disease |
    • | disease | | is a | | SNOMED CT Concept |

  • | bacterial pneumonia | | is a | | bacterial infectious disease |
  • | bacterial infectious disease | | is a | | infectious disease |
    • | infectious disease | | is a | | disease |
    • | disease | | is a | | SNOMED CT Concept |

Figure 56: Inverted hierarchical view of the Supertypes of | bacterial pneumonia |

6.1.3 Defining characteristics

6.1.3.1 Role of defining characteristics
Subtype relationships contribute the hierarchical type based aspect of a Concept definition. This is augmented by defining characteristics that represent the values of a range of relevant attributes. Depending on the nature of the concept these may include including etiology, topography, method, etc. The range of attributes applicable depends on the type of Concept. For example, a procedure may have a method, and a disorder may have an etiology, but a procedure cannot have an etiology, and disorder cannot have a method.

Defining characteristics using a particular attribute will be applied consistently to all Concepts to which it is relevant. Note that this design principle may not be fully realised for all attributes in each release.

6.1.3.2 Representation of defining characteristics
Defining characteristics are represented as Relationships. The fields are used as follows:
• SourceId refers to the Concept to which a defining characteristic applies;
• Typeld indicates the nature of the defining attribute;
• DestinationId refers to the Concept that represents the value of that attribute.
In each release the supported defining characteristics for every Concept are distributed in the relationship file. The supported defining characteristics are descendants of the concept 410662002 | concept model attribute |. The list of supported defining attributes is provided in Defining Attributes by Hierarchy and Domain 9.

Table 96: Defining characteristics applied to an example concept

<table>
<thead>
<tr>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>is a</td>
</tr>
<tr>
<td>Primitive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>infectious disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>is a</td>
</tr>
<tr>
<td>causative agent</td>
</tr>
<tr>
<td>Primitive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bacterial infectious disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>is a</td>
</tr>
<tr>
<td>causative agent</td>
</tr>
<tr>
<td>fully defined</td>
</tr>
</tbody>
</table>

disease of respiratory system

| is a | disease |
| finding site | respiratory system structure |
| fully defined | All diseases with | finding site | | respiratory system structure | are | Disorder of respiratory system | |

disease of lung

| is a | disease of respiratory system |
| finding site | lung structure |
| fully defined | All diseases of respiratory system with | finding site | | lung | are | Disorder of lung | |

9 Note that the Relationships shown in the table and diagram are not the definitive released Relationships of these Concepts. They have been simplified to illustrate particular points in the text.
Pneumonia is a disease of lung finding site lung structure. Not all diseases of lung are pneumonia. No additional characteristics specify what attributes are needed to specify pneumonia.

Infective pneumonia is an infectious disease pneumonia causative agent infectious agent finding site lung structure. All pneumonias with causative agent infectious agent are infective pneumonia.

Bacterial pneumonia is a bacterial infectious disease infective pneumonia causative agent bacteria finding site lung structure. All pneumonias with causative agent bacteria are bacterial pneumonia.

6.1.4 Qualifiers and refinement

6.1.4.1 Qualifiers and refinable definitions

A qualifying characteristic is an attribute that may have one of several possible values for a particular Concept. If a particular qualifier is applied to a Concept, the resulting expression represents a more tightly defined subtype of that Concept.

Example: It might be possible to qualify a disorder such as bacterial pneumonia according to its clinical course (acute or chronic) or severity ("mild," "moderate" or "severe"). With appropriate qualifiers, "injury of skin of the left side of face" could then be represented even if a single Concept Identifier cannot express this.

A similar tightening of the definition of a Concept can be achieved by allowing one or more of the defining characteristics associated with a Concept to be refined. A defining characteristic is refined by an expression that applies a specified subtype of the value stated in the definition.

Example: Fracture of bone could be refined by qualifying it with the finding site "tibia" to represent the Concept Fracture of tibia.
6.1.5 Primitive and fully-defined Concepts

A Concept is considered to be fully defined if its defining characteristics are sufficient to define it relative to its immediate supertype(s). A Concept which is not fully defined is Primitive and this is indicated by the value of the definitionStatusId field.

Example: Pneumonia is a lung disease but unless defining characteristics are specified that effectively distinguish pneumonia from other lung diseases then it is regarded as a primitive Concept.

If a Concept is primitive then the defining characteristics for that Concept are incomplete. It is not possible to automatically compute that a Concept represented as a postcoordinated combination of several Concepts is or is not a subtype of a particular primitive Concept.

Example: The Concept "lung disease" qualified by causative agent = bacteria may be pneumonia, but could also be "bronchitis."

In contrast if a Concept is fully defined it is possible to state that any Concept represented as a combination of the same defining characteristics is equivalent to or a subtype of that Concept.

Example: Assume that the Concept | bacterial pneumonia | is fully defined as | infective pneumonia | with | causative agent | = | bacteria | and that | pneumococcus | is a | bacteria |. It then follows that the post coordinated representation of | pneumococcal pneumonia | as | infective pneumonia | with | causative agent | = | pneumococcus | is computably a subtype of | bacterial pneumonia. |

6.1.6 Important Concept Identifiers

Table 97: Root Concept and Subtype Relationship

<table>
<thead>
<tr>
<th>Id</th>
<th>Preferred Term</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>138875005</td>
<td>SNOMED CT Concept</td>
<td>All Active Concepts are subtype descendants of this Root Concept. The Root Concept has a current Synonym representing the release date.</td>
</tr>
<tr>
<td>116680003</td>
<td>is a</td>
<td>Relates a Concept to its immediate supertype Concepts.</td>
</tr>
</tbody>
</table>

Table 98: Top-Level Concepts

<table>
<thead>
<tr>
<th>Id</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>123037004</td>
<td>body structure</td>
</tr>
<tr>
<td>404684003</td>
<td>clinical finding</td>
</tr>
<tr>
<td>308916002</td>
<td>environment or geographical location</td>
</tr>
<tr>
<td>272379006</td>
<td>event</td>
</tr>
<tr>
<td>363787002</td>
<td>observable entity</td>
</tr>
<tr>
<td>410607006</td>
<td>organism</td>
</tr>
<tr>
<td>Id</td>
<td>Preferred Term</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>373873005</td>
<td>pharmaceutical / biologic product</td>
</tr>
<tr>
<td>78621006</td>
<td>physical force</td>
</tr>
<tr>
<td>260787004</td>
<td>physical object</td>
</tr>
<tr>
<td>71388002</td>
<td>procedure</td>
</tr>
<tr>
<td>362981000</td>
<td>qualifier value</td>
</tr>
<tr>
<td>419891008</td>
<td>record artefact</td>
</tr>
<tr>
<td>243796009</td>
<td>situation with explicit context</td>
</tr>
<tr>
<td>48176007</td>
<td>social context</td>
</tr>
<tr>
<td>123038009</td>
<td>specimen</td>
</tr>
<tr>
<td>254291000</td>
<td>staging and scales</td>
</tr>
<tr>
<td>105590001</td>
<td>substance</td>
</tr>
<tr>
<td>106237007</td>
<td>linkage concept</td>
</tr>
<tr>
<td>370115009</td>
<td>special concept</td>
</tr>
<tr>
<td>9000000000441003</td>
<td>SNOMED CT Model Component</td>
</tr>
</tbody>
</table>

Table 99: Special Concepts

<table>
<thead>
<tr>
<th>Id</th>
<th>Preferred Term</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>370115009</td>
<td>special concept</td>
<td>A top-level Concept that has as its immediate subtypes a set of Concepts that are used to support the functionality of the terminology rather than to represent real-world Concepts.</td>
</tr>
<tr>
<td>363743006</td>
<td>navigational concept</td>
<td>A Special Concept that has as its immediate subtypes all active Navigation Concepts.</td>
</tr>
<tr>
<td>Id</td>
<td>Preferred Term</td>
<td>Comment</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>246061005</td>
<td>attribute</td>
<td></td>
</tr>
<tr>
<td>410662002</td>
<td>concept model attribute</td>
<td></td>
</tr>
<tr>
<td>260507000</td>
<td>access</td>
<td></td>
</tr>
<tr>
<td>246090004</td>
<td>associated finding</td>
<td></td>
</tr>
<tr>
<td>116676008</td>
<td>associated morphology</td>
<td></td>
</tr>
<tr>
<td>363589002</td>
<td>associated procedure</td>
<td></td>
</tr>
<tr>
<td>47429007</td>
<td>associated with</td>
<td></td>
</tr>
<tr>
<td>255234002</td>
<td>after</td>
<td><em>Subtitle of</em> associated with.</td>
</tr>
<tr>
<td>246075003</td>
<td>causative agent</td>
<td><em>Subtitle of</em> associated with.</td>
</tr>
<tr>
<td>42752001</td>
<td>due to</td>
<td><em>Subtitle of</em> associated with.</td>
</tr>
<tr>
<td>263502005</td>
<td>clinical course</td>
<td></td>
</tr>
<tr>
<td>246093002</td>
<td>component</td>
<td></td>
</tr>
<tr>
<td>363701004</td>
<td>direct substance</td>
<td></td>
</tr>
<tr>
<td>246456000</td>
<td>episodicity</td>
<td></td>
</tr>
<tr>
<td>408729009</td>
<td>finding context</td>
<td></td>
</tr>
<tr>
<td>419066007</td>
<td>finding informer</td>
<td></td>
</tr>
<tr>
<td>418775008</td>
<td>finding method</td>
<td></td>
</tr>
<tr>
<td>363698007</td>
<td>finding site</td>
<td></td>
</tr>
<tr>
<td>127489000</td>
<td>has active ingredient</td>
<td></td>
</tr>
<tr>
<td>363705008</td>
<td>has definitional manifestation</td>
<td></td>
</tr>
<tr>
<td>411116001</td>
<td>has dose form</td>
<td></td>
</tr>
<tr>
<td>363702006</td>
<td>has focus</td>
<td></td>
</tr>
<tr>
<td>363703001</td>
<td>has intent</td>
<td></td>
</tr>
<tr>
<td>Id</td>
<td>Preferred Term</td>
<td>Comment</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>363713009</td>
<td>has interpretation</td>
<td></td>
</tr>
<tr>
<td>116686009</td>
<td>has specimen</td>
<td></td>
</tr>
<tr>
<td>363714003</td>
<td>interprets</td>
<td></td>
</tr>
<tr>
<td>272741003</td>
<td>laterality</td>
<td></td>
</tr>
<tr>
<td>370129005</td>
<td>measurement method</td>
<td></td>
</tr>
<tr>
<td>260686004</td>
<td>method</td>
<td></td>
</tr>
<tr>
<td>246454002</td>
<td>occurrence</td>
<td></td>
</tr>
<tr>
<td>123005000</td>
<td>part of</td>
<td></td>
</tr>
<tr>
<td>370135005</td>
<td>pathological process</td>
<td></td>
</tr>
<tr>
<td>260870009</td>
<td>priority</td>
<td></td>
</tr>
<tr>
<td>408730004</td>
<td>procedure context</td>
<td></td>
</tr>
<tr>
<td>405815000</td>
<td>procedure device</td>
<td></td>
</tr>
<tr>
<td>363699004</td>
<td>direct device</td>
<td>Subtype of</td>
</tr>
<tr>
<td>363710007</td>
<td>indirect device</td>
<td>Subtype of</td>
</tr>
<tr>
<td>424226004</td>
<td>using device</td>
<td>Subtype of</td>
</tr>
<tr>
<td>425391005</td>
<td>using access device</td>
<td>Subtype of</td>
</tr>
<tr>
<td>405816004</td>
<td>procedure morphology</td>
<td></td>
</tr>
<tr>
<td>363700003</td>
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### 6.2 Concept Model Specification

This section specifies the main hierarchies of the *SNOMED CT Concept Model* and the attributes and values used to define concepts in particular hierarchies.

#### 6.2.1 Scope and boundaries

The scope of *SNOMED CT* has been driven by its historical legacy and by the perceived requirements of current user communities. Scope can be defined separately for three dimensions: 1) domain coverage or breadth, 2) granularity or depth, and 3) knowledge representation.

#### 6.2.1.1 Scope of domain coverage

The terminology domains covered by *SNOMED* include:

- Clinical findings, including disorders
• Procedures, broadly defined as including all health related activities such as history taking, physical examination, testing, imaging, surgical procedures, disease-specific training and education, counseling, and so forth.
• Observable entities which, when given a value, provide a specific finding or assertion about health related information. Examples include the names of lab tests, physical exam tests, dates of significant events, and so forth.
• Anatomy, morphology, and other body structures
• Chemicals and other substances of relevance to health and health care, including generic drug ingredient names, generic drug products (virtual medicinal products)
• Generic physical devices relevant to health care, or to broad categories of injury or accident
• Organisms relevant to health and health care of humans and animals
• Other aetiologies of disease, including external forces, harmful events, accidents, genetic abnormalities,
• Functions and activities
• Social contexts relevant to health, including general categories of status of employment, education, housing, care provision, family Relationships, and so forth.
• Types of clinical records, documents, certificates and other records and record components relevant to health care.
• Staging, scales, classifications, and other miscellaneous health information
• Attributes and values necessary to organise and structure the terminology

Note: Non-human concepts: In versions of SNOMED CT prior to 2014, there were many strictly non-human concepts. These have now been moved to an extension. Many codes are applicable to both human and non-human subjects, and of course these have not been moved.

6.2.1.2 Scope of granularity
Terms and meanings in the terminology can be characterised by a point on a scale from very general to very specific. The degree to which the terminology includes highly specific terms is often referred to as granularity. More properly, terms can be said to be at a level that is coarsely granular, or at a level that is finely granular.

At upper levels, SNOMED CT accepts coarsely granular meanings that are useful only for aggregation and are not useful for individual patient data recording. Examples include clinical finding, procedure, measurement procedure, etc. Progressive levels of refinement are allowed to the extent required to meet clinical data requirements. There are, however, limits to the degree of precoordination of certain types of complex statements. There is a general rule that the terms in SNOMED CT should name things that exist in the real world, and therefore they should tend to be names or short noun phrases, not complete sentences and certainly not paragraphs. The terminology originated as a nomenclature, and it is intended to be used in concert with an information model that can carry full clinical statements along with their attribution, dates, times, and statement inter- Relationships. There is an evolving understanding of the boundary between items named in the terminology and more complex statements that should be represented as combined terminology-information elements.

More detailed advice and guidance can be found in the section “Content Inclusion: Principles and Process” below.

6.2.1.3 Scope of knowledge representation
SNOMED logic-based definitions represent terminological knowledge. In other words, they represent what is always necessarily true about the meaning of a code. The logic definitions are not intended to cover the entire range of medical knowledge, and are not intended to include probabilistic or uncertain knowledge. Such knowledge is beyond the scope of SNOMED CT’s logic definitions.

For example, consider myocardial infarction (MI). terminological knowledge about this entity includes the fact that it must involve the myocardium, and it must involve an infarction. Additional knowledge that is not terminological, and therefore not included in the SNOMED logic definition, might include the fact that an MI is usually associated with crushing substernal chest pain, diaphoresis, arrhythmia, ST-segment elevation on EKG, and elevated levels of cardiac enzymes. Not every case of MI will have chest pain, nor will every case show ST segment elevation, etc. While these are valuable clues to the diagnostician, they are not necessarily always present, and therefore they are not part of the terminological knowledge base. As another example, consider appendicitis. terminological knowledge about this entity includes the
fact that it is a kind of inflammatory disorder, and that it involves the appendix. Additional knowledge that
is not terminological might include the fact that it often involves central abdominal pain that migrates to
the right lower quadrant, and that it is associated with anorexia, nausea, elevated white blood count, and
rebound tenderness over McBurneys point. These additional pieces of knowledge are variably present
and therefore represent uncertain or probabilistic knowledge. Such variable or probabilistic knowledge is
highly valuable for decision support algorithms, but is beyond the scope of SNOMED CTs logic definitions.

6.2.1.4 Content Inclusion Principles and Process

6.2.1.4.1 Content Inclusion - Problem Statement

The basic problem to be addressed is that of deciding whether new content
should be added to SNOMED CT, and if so, should it be in the international release or in an extension.
This document attempts to provide basic principles and specific guidelines and examples, as well as a
process that can be followed to resolve difficult or contested decisions.

6.2.1.4.1.1 Identifying Acceptable and Unacceptable Content

The range of concepts, terms, and other components in SNOMED CT is extremely broad
in order to support the terminological needs of information systems that support the health and health
care of individuals. Nevertheless, within this broad scope there are items for which some groups or
individuals may want to have a “code”, but which are ruled as unacceptable for SNOMED CT. This
document aims to identify some rules and mechanisms by which unacceptable content can be identified.

6.2.1.4.1.2 What is the “core”?

The word “core” has been used with several different meanings and therefore should not be
used without qualification. In this document we will address the question of whether content should be
included in SNOMED at all, and also the question of whether it should be in the “core” international
release. This is the content that is maintained and distributed by IHTSDO.

6.2.1.4.1.3 What is an extension?

A SNOMED CT Extension is a set of terminology components and derivatives that add to
and are dependent on the SNOMED CT International Edition, and are created, structured, maintained
and distributed in accordance with SNOMED CT specifications and guidelines.

All extensions are dependent on the SNOMED CT International Edition and can be used to broaden the
scope of coverage and/or to configure the terminology for use in a specific language, specialty or
jurisdiction. IHTSDO Members may create, maintain and distribute extensions to address specific national,
regional and language requirements. IHTSDO Affiliates may also create, maintain and distribute extensions
to meet the needs of particular software solutions and customers.

Each component created as part of an extension had an unique identifier (SCTID) that includes the
namespace identifier assigned, by IHTSDO, to the organisation responsible for that extension. The
organisation responsible for an extension is required to create, maintain and distribute components and
derivatives in accordance with IHTSDO specifications and guidance. This ensures that extensions are
compatible with the structure and content of the SNOMED CT International Edition.

Namespace identifiers are allocated in response to requests from IHTSDO Members and Affiliates. For
further information about this process and for access to the current SNOMED CT Namespace Register
please refer to the IHTSDO web page on Namespaces.

It is important to emphasise that the IHTSDO definition of extension is a narrow one. Other types of
add-ons, enhancements or expansions that may of increasing the usefulness of SNOMED CT in various
application domains are not regarded as SNOMED CT Extensions.

Notes:

1. Components that are created in an extension are identified using extension SCTIDs. These
identifiers include an extension namespace which ensures that they do not collide with other
SCTIDs, and can be traced to an authorised originator.

2. Namespace identifiers are allocated in response to requests from IHTSDO Members and Affiliates.
For further information about this process and for access to the current SNOMED CT Namespace
Register please refer to the IHTSDO web page on Namespaces.
3. **IHTSDO Members** may create, maintain and distribute **extensions** to address specific national, regional and language requirements. **IHTSDO Affiliates** may also create, maintain and distribute **extensions** to meet the needs of particular software solutions and customers.

4. See also **Edition** which refers to the combination of an **extension** with the **International Release** and, where relevant, any modules from other **extensions** upon which it depends.

### 6.2.1.4.2 Basic principles: Does it belong in SNOMED CT?

Not every possible term or code that is related to health care belongs in **SNOMED**. Some content should be excluded. There has been significant debate about what does and does not belong; these debates are healthy and should continue. This document only attempts to ground the debate in some specific principles that can guide the decisions about what to include and what to exclude.

**SNOMED CT** is intended to be as reusable as possible, and this generates a tension between being all things to all purposes, versus being custom-fit to a particular purpose. The most general statement that can be made is that **SNOMED CT** is designed to foster semantic interoperability of electronic health applications.

#### 6.2.1.4.2.1 Creation and maintenance of semantic interoperability

The most basic principle for determining whether content belongs in **SNOMED CT** is that it must create and sustain semantic interoperability of clinical information. This ability in turn depends on a reproducible and consistent approach to the incorporation of terminology into electronic records.

#### 6.2.1.4.2.1.1 URU - Understandable, Reproducible, Useful

Beginning in 1996 with the development of **SNOMED RT**, the **SNOMED** modelers began to follow three basic operational criteria that help determine whether new content is following the principle of creating and sustaining semantic interoperability. These tests were summarised with the acronym "URU", standing for:

- **Understandable**: The meaning must be able to be communicated to and understood by an average health care provider without reference to inaccessible, hidden or private meanings
- **Reproducible**: It is not enough for one individual to say they think they understand a meaning. It must be shown that multiple people understand and use the meaning in the same way.
- **Useful**: The meaning must have some demonstrable use or applicability to health or health care.

#### 6.2.1.4.2.2 Coordination with and exposure of information architecture components

The overall semantic interoperability of **electronic health records** is derived from the combined functioning of an information architecture and the terminology that populates it. Yet **SNOMED CT** itself does not produce – and does not dictate the choice of – the information architecture. The best we can do is to make explicit those elements of **SNOMED CT** that would be possible to represent in some alternative ways using the information architecture.

#### 6.2.1.4.2.2.1 SNOMED CT Codes name classes of things

**SNOMED CT** is a systematic way of naming concepts that uses codes to represent classes or categories of real things. The terms should be names that are human-understandable representations of the codes. With reference to the semiotic triangle, the codes should be considered symbols that refer to classes or categories of real things. New content should be rejected if it consists of full sentences and statements rather than names that can be used in statements.

New content that refers to, or contains references to, a particular instance, should also be rejected. For example, "Doctor Jones’ pre-operative order set" can be rejected on the grounds that Doctor Jones is an instance (individual) and not a class.

#### 6.2.1.4.2.2.2 Clinical statements are made using codes within the information architecture

There is a tension between the purity of a nomenclature and the needs of information system implementers. Many system implementers are working with impoverished information models, and to deny them certain coded content is to prevent their use of **SNOMED CT** at all. In the past we have acknowledged this fact and attempted to maximise usefulness while minimising the *precoordination* of all possible clinical statements.
6.2.1.4.2.3 Comprehensiveness of domain coverage

Within the content currently in SNOMED CT, there are some areas that are covered with a great deal of completeness, and others that are not. It is a goal for SNOMED CT, and one of the main features of any good clinical terminology, to be comprehensive in those areas that it chooses to cover.

Decisions about inclusion of an individual piece of content should therefore be made on the basis of whether the domain to which it belongs is one that is being comprehensively supported in SNOMED CT. For example, "organisms affecting human and veterinary health" would be an example of a domain which has previously been included in the core. An organism meeting this criterion can therefore be judged as belonging.

A list of domains currently being maintained is included in Scope of domain coverage on page 216.

Even within a particular broad domain, there may be sub-domains that should be added comprehensively rather than piecemeal. For example, there are many new genetic tests not currently included in SNOMED CT. The general approach to addition should be to add these as a large batch that is quality assured and reviewed for overlaps and gaps and inconsistencies. They should not be added one or two at a time, because this would be inefficient and error-prone and would not serve users' needs well.

6.2.1.4.3 Principles for accepting content into the international release

The fundamental statement of the scope of the international release is that it includes content necessary for international conformance and interoperability.

Content that is defined as being within the scope of the international release is restricted to the international release and may not be modified or replaced by an extension, unless explicitly permitted by IHTSDO. For content that is within scope for SNOMED CT, other criteria must be met in order to require that it must be included in the international release:

- Is the concept necessary for health information conformance and interoperability?
- Multi-national – Is it useful in more than one national healthcare system?
- Conformance – Does it need to be understandable in health information systems within more than one national healthcare system?
- Interoperable – Does it need to be shared so that information systems can use it in a reproducible manner beyond a patient’s national healthcare system, if a patient were to travel or relocate to a different country?

6.2.1.4.3.1 Use of Proprietary Names and Works

1. Introduction

This section considers scope issues arising from the incorporation into SNOMED CT of proprietary names (such as names of clinical forms and drugs) and content from clinical forms and tools. The section is divided into two sub-sections. Subsection 2 deals with considerations for the IHTSDO itself. Subsection 3 deals with considerations for third parties (such as IHTSDO Affiliates) who implement SNOMED CT in clinical systems. There is a degree of overlap between these sections, but the issues are not identical. In this section, we refer to the 'owner' of a clinical form or tool. This term is used loosely to refer to whichever person or organisation owns whatever intellectual property rights exist in the form or tool. This may be the individual or group of individuals who originally created the form or tool, or it may be the healthcare organisation that employed them at the time of creation. We are also aware of cases in which the original creators of a clinical form have assigned their intellectual property rights to a commercial organisation which now administers the licensing of the form to organisations who wish to use it.

2. Issues for the IHTSDO

a. Incorporation of names

The mere incorporation into SNOMED CT of the name of a clinical form or tool (e.g. the 'XYZ Test'), or the name of the score generated by a form or tool (e.g. the 'XYZ Test Score') will not require a licence from the owner. It is possible that the owner holds a trade mark (which may be registered or unregistered) representing the name or score, but simply incorporating that word into SNOMED CT is not an act that would infringe the trade mark.
This also applies to 'brand name' drugs (as opposed to generic drugs). The IHTSDO does not need to obtain the permission of the trade mark owner simply to include a reference to the drug in SNOMED CT.

b. Incorporation of questions

A clinical form or tool, including the wording of the individual questions within the form or tool, will generally be a literary work and will qualify for copyright protection. The copying of all or any substantial part of a literary work, without a licence from the owner, will infringe the owner's copyright.

It is possible, though unlikely, that the incorporation of the wording of an individual question from a clinical form or tool may infringe the owner's copyright. However, we understand that it is much more likely that the IHTSDO would need to systematically include all of the questions from the form or tool in SNOMED CT. Except in the case of the simplest of forms, that is likely to infringe the owner's copyright without a licence from the owner.

c. Incorporation of answers

Certain questions may have a range of pre-determined answers. This could be as simple as 'yes / no' or a number within a specific range (e.g. 0, 5 or 10), but may also be more substantial text (e.g. 'needs help cutting', spreading butter, etc., or 'requires modified diet').

Clearly, incorporating very simple answers into SNOMED CT (such as numbers or 'yes' / 'no') will not require the permission of the owner. However, incorporating more substantial text into SNOMED CT will generally infringe the owner's copyright. This will usually not apply to individual answers, but it will almost always be the case where entire sets of answers (e.g. all possible answers to a question) are incorporated.

d. Incorporation of scores

The principles that apply to individual answers also apply to the overall score generated by a clinical form or tool.

The incorporation of mere numbers will not infringe the owner's copyright. However, in cases where each possible score has an associated textual description and all the possible scores are incorporated into SNOMED CT, together with their associated descriptions, a licence would be required from the owner.

e. Incorporation of 'concepts' representing questions, answers or scores

We have considered the possibility that, instead of the text of questions, answers or scores being incorporated into SNOMED CT, a concept may be introduced that represents one or all of these.

For example, a form may include a question about a person's ability to dress and a range of possible answers. The IHTSDO might want to incorporate neither the text of the question nor any of the possible answers into SNOMED CT, but instead might want to incorporate a single concept such as 'ability to dress'. Similarly, if the form contains 20 questions, the IHTSDO might want to introduce 20 concepts into SNOMED CT, for 'XYZTest_Result1', 'XYZTest_Result2' and so on, up to 'XYZTest_Result20'.

As with the questions, answers and scores, the incorporation of a single concept into SNOMED CT based on a question, answer or score on a clinical form is highly unlikely to infringe the owner's copyright. However, if the IHTSDO were systematically to introduce a concept into SNOMED CT for every single question on a clinical form, that is likely to amount to copying a substantial amount of the work and would infringe the owner's copyright. The fact that there may be no verbatim or 'literal' copying from the work does not prevent a court from holding that there has been substantial taking from the work, and that there has therefore been an infringement of copyright.

We have also considered the possibility that these concepts (e.g. 'ability to dress') may already exist within SNOMED CT, or be added to it, because they arise in other contexts. (Obviously, this does not apply to concepts that represent specific questions within a form.) Copying is an essential element of any action for breach of copyright – if the owner cannot show that the concepts exist in SNOMED CT because they have been copied (whether or not literally) from the owner's work, the owner will not succeed in an infringement action against the IHTSDO.

3. Issues for Implementers of SNOMED CT

a. Incorporation of names
The mere use in a clinical system of the name of a clinical form or tool, or the name of a ‘brand name’ drug, will usually not amount to trade mark infringement. We say “usually” here because there is a very wide variety of systems in which SNOMED CT may be implemented, and particular caution should be exercised by implementers who wish to use trade marks in a ‘commercial’ context (such as systems that enable drugs to be purchased electronically). The IHTSDO avoids giving any specific advice to system implementers on this matter, and advises that implementers who are in any doubt should be encouraged to contact the trade mark owner to discuss whether they require a licence.

In any event, system implementers would be advised to make no greater use of a trade mark than is necessary. For example, while displaying the text of a trade mark may not amount to an infringement, it would be preferable to avoid displaying any associated graphical mark (such as a logo) in screen displays or printed output.

b. Incorporation of questions, answers and scores

The considerations that apply to the IHTSDO's incorporation of questions, answers and scores into SNOMED CT also apply to system implementers. In cases where the incorporation of content from a clinical form or tool infringes a third party's copyright, that copyright will also usually be infringed by a system that reproduces that content (such as on a screen display or printed output). This means that, if the IHTSDO requires a licence to incorporate the content, that licence should ideally also cover use by system implementers.

There are two additional issues for implementers of SNOMED CT.

First, as noted above, it is possible that terms that are found in a clinical form may already exist within SNOMED CT, even though they have not been copied from the form in any way. As noted above, this would not amount to copyright infringement by the IHTSDO, since there would be no copying. However, if a system implementer chooses to arrange a collection of these pre-existing terms in a way that then reproduces all or a substantial part of a clinical form (for example, by populating a drop-down box with all the possible answers to a specific question that appears on the form), that may infringe the owner's copyright, even though those terms existed separately within the SNOMED CT database tables.

Secondly, a system may reproduce the structure and layout of a clinical form on a screen display or printed output (for example, to make the system more accessible to users who are familiar with a paper-based form). This may well infringe the owner's copyright in the form, unless the layout is very trivial (e.g. a bullet-point list). Certainly, any implementer who wishes to emulate the 'look and feel' of a clinical form within its system would be advised to seek a licence from the relevant owner.

c. Incorporation of algorithms or ‘logic’

Another issue that would apply specifically to system implementers is the use of the algorithms or ‘logic’ inherent in a clinical form or tool, such as the method by which an overall score is calculated. For example, a clinical form may instruct the user to perform a mathematical operation on the individual answers to produce the overall score, and the same operation may be carried out by the system.

Of course, since the infringement would result from the use of the algorithm, the fact that terms from the underlying form may also be represented in SNOMED CT would be merely incidental. For this reason, the IHTSDO avoids becoming involved in any such issues, and encourages system implementers to contact the relevant owner if they are in any doubt as to whether the use of an algorithm may infringe the owner’s rights.

6.2.1.4.3.2 Management of Non-Human Content

Non-human content may be included in a request for new content via the SNOMED International Request System (SIRS) or may be identified in the international release. Due diligence is required to differentiate content that belongs in the “core”, meaning the International Release of SNOMED CT, versus content that can be handled in an extension. The basic principle is that content that may be useful in human medicine belongs in the core. Content that is strictly non-human may be managed in an extension. Examples of non-human content include:

- Egg related coelomitis (disorder)
- Dehorning (procedure)
• Bone structure of wing (body structure)

Criteria for individual types of content that should be in the core include the following:

• Diseases and findings: Anything that can occur in both humans and animals should be in the core.
• Material entities: Every substance that can cause adverse effects should be in the core, with the understanding that poisonings and adverse effects can occur in humans caused by virtually any substance regardless of its intended purpose or origin. As the substance hierarchy begins to differentiate more clearly between molecular entities, collectives, mixture and other material entities, it may be that some material entities will be of interest only in a non-human or veterinary context, and these could be added to or left in a veterinary extension.
• Organisms: Most organisms should be in the core, but there may be exceptions. There are over 20,000 organism codes in the Veterinary Extension maintained by the Veterinary Terminology Services Laboratory (VTSL) at Virginia Tech. As a general rule, these do not need to be transferred into the core unless they are of value in public health or human medicine, or have been requested to be put in the core by more than one IHTSDO Member Country.
• Requests from veterinary users for organisms that have no known use case in human medicine can be met by adding them to the organism extension content managed by VTSL.

The veterinary extension is publicly available to those in IHTSDO Member Countries and those who hold an Affiliate License. To obtain more information about and access to the veterinary extension, visit http://vtsl.vetmed.vet.edu or contact VTSL at vtsl.extension@gmail.com

6.2.1.4.3.3 Principles for determining National Extension content

The fundamental statement of the scope of a National Extension is that it includes content outside of the scope of the international release, but is necessary for national conformance and interoperability. The interpretation and application of this fundamental scope will depend on the specifics of each member-state’s national healthcare system and is left for each member-state to determine for itself.

Criteria to determine if concepts should be included in the National Extension terminology include:

Is the concept outside the scope of the international release but necessary for national conformance and interoperability?

National – Is it useful throughout the national healthcare system?

Conformance – Does it need to be understandable throughout the national healthcare system?

Interoperable – Does it need to be shared in a reproducible manner within the national healthcare system?

If so, then the concept may be eligible for the National Extension terminology. However, the final decision on inclusion of concepts within a National Extension lies with each member-state.

6.2.1.4.4 Guidelines for submission of new content

It would be impossible to provide specific rules to apply to every case where new content must be assessed, but it is helpful to list some of the recurring decisions in order to provide consistency and full explanations for the reasons that some content submissions are rejected.

New content should optimally be submitted with fully specified names (FSN’s), and these should conform to the editorial guidelines for terms, including spelling, language, and term style guidelines. New content should also be submitted with a “parent” code to show where in the hierarchies it belongs. Assignment of this parent should be according to the editorial policy guidelines (see the other style guide documents for details).

Some common errors in past submissions include misspelled words, words submitted in the FSN that use abbreviations or acronyms, or are spelled using British spelling instead of US spelling, FSNs in plural instead of singular form, procedure FSNs in past tense instead of present tense, FSNs containing short forms with hyphens instead of fully unambiguous phrases, mismatch of the FSN tag and the submitted parent code hierarchy, terms that already exist (duplicates), terms containing “or”, terms with precoordinated numeric ranges, and FSNs that are ambiguous and not fully specified.

Here we add guidelines for content submission that address issues other than the concept model or term style, but must also be considered and can be grounds for rejection of submitted content.
6.2.1.4.4.1 Usefulness

Content submitted to the international release shall be required to pass a test for “usefulness.” The usefulness test can be passed in more than one way. At least one of the following must be satisfied:

1. Content that is used by more than one major user (a National Release Center such as NHS, a vendor/supplier of Clinical Information Systems with international scope, or a large intra-national system user such as VA or Kaiser) will be considered to have passed the “usefulness” criterion.

2. Data demonstrating significant frequency of use, or frequency of need, by a single user (single national centre, or single vendor, or single health care system) can also be used as evidence in support of “usefulness”.

Additional means of passing the usefulness test may be added in the future. Submissions that pass the usefulness criterion must also pass understandability and reproducibility tests, and conform to style rules.

6.2.1.4.4.2 Classification-derived phrases

6.2.1.4.4.2.1 Phrases meaningless outside the classification context

New concept submissions that contain certain classification-derived phrases in their FSN shall be rejected because they fail the basic tests of Understandability, Reproducibility and Usefulness when removed from the narrow constraints of the classification use case. Some such classification-derived phrases are:

- NOS (not otherwise specified)
- NEC (not elsewhere classified)
- Not mentioned
- With or without

The basic reason for rejection of these phrases is that they are meaningless within a clinical terminology that assumes a use case based on primary clinical documentation that allows multiple overlapping entries, rather than coding of a pre-existing record into a single best class.

The classification phrases assume that a health care record already exists, and therefore it is meaningful to have codes that depend on what has been specified or mentioned in that record. Likewise the classification phrases assume that there is a fixed set of classes into which the existing record should be placed, and therefore it is meaningful to have codes that depend on what has been classified elsewhere in the system. Lastly, the classifications must have a class for every case, and therefore they provide additional codes for categorising a case that hasn’t been properly captured by any other code — sometimes called “catch bins”.

SNOMED assumes that the physician or health care provider may be in the process of documenting observations about a patient, and in this setting anything that has fidelity to the clinical situation may be stated and coded. It also assumes that the entire range of reproducible and useful meanings is available to be used to faithfully document the health and health care of the individual, and codes may be selected at any and all levels of specificity if desired. There is no single best code that must be selected, and using one code does not require the exclusion of another code with overlapping meaning. Finally, there are no “catch-bins”, but there are multiple codes at a variety of levels of generality that may be used, and a rich set of qualifiers for refining the meaning of an existing code.

6.2.1.4.4.2.2 Phrases that make full statements or sentences

There are many phrases in classification systems that make statements. These phrases are in a borderline area for acceptance into SNOMED CT. In an ideal world, the information model would provide the mechanism for making these statements and there would be no pressure to precoordinate them into SNOMED CT. In the practical world, many users of existing systems are attempting to migrate from ICD-9-CM or similar coding systems towards SNOMED CT, and in the process they require maximum possible concurrence between the codes they are currently using and the codes to which they are migrating.

Nevertheless, SNOMED CT requires that when such concepts are included, they must have a fully specified name that omits all classification-style phrases and meets URU criteria. This may be difficult to achieve because of the idiosyncratic nature of some classification additions.
6.2.1.4.4.2.2.1 Example: episode of care and pregnancy complications

For example, ICD-9-CM adds a series of complicated “episode of care” phrases to several of the categories of disorders affecting pregnancy and delivery. Here is the full set of “fifth digit” modifiers for complications related to pregnancy:

The following fifth-digit subclassification is for use with categories 640-649 to denote the current episode of care:

- **0** unspecified as to episode of care or not applicable
- **1** delivered, with or without mention of antepartum condition
  - Antepartum condition with delivery
  - Delivery NOS (with mention of antepartum complication during current episode of care)
  - Intrapartum obstetric condition (with mention of antepartum complication during current episode of care)
  - Pregnancy, delivered (with mention of antepartum complication during current episode of care)
- **2** delivered, with mention of postpartum complication
- **3** antepartum condition or complication
  - Antepartum obstetric condition, not delivered during the current episode of care
- **4** postpartum condition or complication
  - Postpartum or puerperal obstetric condition or complication following delivery that occurred:
    - during previous episode of care
    - outside hospital, with subsequent admission for observation or care

The first task is to strip away all “mention of” and “unspecified” phrases, and then determine whether there is still a URU meaning. A fifth digit of “0” generates no special meaning for SNOMED and the phrase “unspecified as to episode of care” would be rejected as invalid for an FSN. Therefore SNOMED CT cannot incorporate any code that corresponds to the “0” fifth digit here.

A fifth digit of “1” means that the current episode of care involved delivery and the complication finding was antepartum. Some submitters might want to have a short phrase that says something like “finding X, delivered”, where the finding occurred antepartum and the mother was delivered during the current episode of care. This constitutes two statements and our recommendation would be to place each statement in the patient record separately. However, given the request for a single precoordinated code that captures both meanings, it is possible to use the SNOMED CT context model, with two role groups, to capture the two statements.

A specific code, 641.91, would carry the ICD-9-CM phrase “Unspecified antepartum haemorrhage, delivered, with or without mention of antepartum condition”.

Obviously there is a great deal of revision required to make this acceptable (even marginally) to SNOMED. The “unspecified” and “with or without mention of” phrases must be dropped. Clarification must be added to indicate whether it is the mother or foetus who is the subject of the record. The “episode of care” meaning is hard to capture in SNOMED and would be largely unrepresentable. This process might result in an FSN that says “history of antepartum haemorrhage, mother delivered (situation)”, which could be defined as:

Situation, {associated-finding = antepartum haemorrhage, temporal-context = past},

{associated-finding = mother delivered, temporal-context = current or specified}

This expression does not completely capture all the subtle meanings associated with the ICD-9-CM code 641.91, but it is perhaps as close as we can come without major changes.

In general, precoordination of such codes is to be denigrated and discouraged because of the false sense of completeness it gives to those seeking to link SNOMED and ICD-9-CM (the meanings are not the same and cannot be), and because of the added complexity such compositional expressions may present to decision support algorithms, particularly those that require automated processing of temporal Relationships. In the example given, a statement in a patient record using this code cannot tell us when the antepartum haemorrhage took place. It only tells us that it was sometime in the past – prior to delivery. The expression as given actually matches cases where the antepartum haemorrhage took place in a prior pregnancy. This temporal linkage problem would be avoided by using two statements with two time
stamps, one coding the complication (and recording the time when it occurred) and the other one for the delivery.

6.2.1.4.4.2.3 Disjunctive aggregates

Frequently classifications employ disjunction (and/or) to group and aggregate related disorders or procedures. For example, a procedure classification might have a term for “total abdominal hysterectomy with unilateral or bilateral oophorectomy”. From a procedure classification standpoint it may be appropriate to lump these all together; but from a patient standpoint, a unilateral oophorectomy leaves oestrogen-producing capacity while a bilateral does not, and this is very important to the patient and to their health care.

The general rule is that a FSN should be capable of being stated without and/or. There are occasional exceptions. The first exception is where the referent is a single thing but there is no name for it. These occur in anatomy. For example, “head and neck” is really a single anatomical structure that can be defined as the body above the level of the shoulders. We don’t have a name and so we use disjunction to name this body part. The second exception is where the term is an intentional navigational aggregate term. For example, we might want to group together disorders that relate to life up to the end of the neonatal period, and group them using a term such as “fetal or perinatal or neonatal disorders”. But outside these broad navigational aggregate terms, it is advisable to reject disjunctive terms and instead create separate terms to be more specific about what a particular disorder is, or what particular procedure was performed.

It requires some judgement to identify the allowable exceptions, but the general rule is that FSNs should not contain disjunctions. An example of an allowable exception is | Structure of skin and/or skin-associated mucous membrane (body structure) |. The reason it is allowed is that it is useful for representing the general site of dermatological disorders, and this is useful, understandable and reproducible, from both a pathophysiological and therapeutic standpoint.

6.2.1.4.4.2.4 Excessive precoordination

It has not been possible to clearly define what “excessive” precoordination is. Instead, we rely on the rules for usefulness to avoid this.

6.2.1.4.4.3 Numeric ranges

Categories that depend on numeric ranges are almost always inappropriate for precoordination. For example, a finding of the number of lesions might be split up into ranges of 1, 2 to 5, and greater than 5. But in another context it might as easily be split into ranges of 1-2, 3 to 10, and greater than 10. It is obvious that there are literally infinite possibilities (in theory) and practically far too many possibilities to consider precoordinations of this type.

Rare exceptions may be made when a fixed standard uses numeric ranges and there are no reasonable alternatives. For example, some histologic scoring systems give a score of “1” when there are 0 to 5 mitoses per high power field, and a score of “2” when there are 6 to 10, etc. In these cases, where the range is really an explanation or definition of the score, it may be reasonable to make an exception.

On the other hand, it is important to avoid precoordination of knowledge that should reside external to SNOMED CT terms. For example, the serum sodium concentration is in the “normal range” when between 135 and 145 mEq/L, but for low sodium SNOMED CT should not use the phrase “serum sodium less than 135 mEq/L”, but instead should use a phrase such as “serum sodium concentration low”, and not attempt to include the definition of the lower limit of the reference range. The reason for this should be obvious — that is, sometimes reference ranges change, and sometimes systems of units change and it would cause unnecessary disruption if the SNOMED CT terms were dependent on those external factors. It should be forbidden to precoordinate these kinds of numeric ranges into SNOMED CT terms where it is not absolutely necessary.

6.2.1.4.4.4 Procedures categorized by complexity

Procedure concepts that include modifiers that represent procedure complexity based on the amount of effort required, or based on realm-specific definitions, are not to be added to the international release.

Examples of prohibited concepts:

Simple arthrodesis, simple repair, complex repair.
This policy does not proscribe the additions of procedures that use the words “simple” or “complex” which are defined by reproducible meanings based on what is done to or for the patient, rather than how much effort is expended in doing it.

Example of acceptable definition:

Simple mastectomy: Reproducibly defined as the removal of all breast tissue without removal of axillary contents. Differentiated from modified radical, radical, skin-sparing, and subcutaneous variants of mastectomy.

6.2.1.4.4.5 Counts of the number of procedures done

Many procedure classifications focus on the amount of resource required to carry out a procedure in order to support use cases involving reimbursement or tracking of resource expenditures. For this reason there may be a desire to precoordinate different codes for different counts of a procedure. For example, consider “placement of one stent” vs “placement of two stents”.

The general advice is that the counts of number of procedures done should be handled by the information model of the patient record, and should not be precoordinated into SNOMED CT codes.

6.2.1.4.4.6 Acronyms

Acronyms are an abbreviation formed from the initial letters of other words and pronounced as a word (e.g. ASCII, AIDS). Here we reiterate the prohibition of acronyms in fully specified names (see Acronyms in FSNs on page 371. Acronyms can be misinterpreted because they are not fully spelled out. It is a mistake to assume that everyone will know what an acronym means. Therefore acronyms may not be used in fully specified names when the fully spelled out name is available. An exception may be where a sequence of letters started as an acronym but has now become a word in its own right, understood without expansion to its original full form. A common example would be “laser”. Evidence that it is a word in its own right is that it is included in dictionaries in lower case, and the fully spelled-out meaning has become a trivia question. An example of an acronym that may not be included in an FSN is “CT” for “computed tomography”. While those involved in imaging and radiology may regard “CT” as a word (pronounced “see tee”), it does not pass the test of being unambiguous, of appearing in a dictionary in lower case, or of its component words being a trivia question.

Acronyms are however allowed in synonyms or preferred terms when accompanied by the full expansion of the abbreviation. Expansions should be enclosed in parenthesis to reduce the technical implementation burden when indexing and searching e.g. CT (Computed tomography).

6.2.1.4.4.7 Eponyms and proprietary names

6.2.1.4.4.7.1 Eponyms

Eponyms are names that are derived from a proper name, usually the name of a person who discovered or described the thing originally. They are commonly found in a wide variety of names in health terminology, ranging across diverse areas such as anatomic structures, morphologic abnormalities, blood groups, diseases, findings, and procedures. Examples include Rutherford Morrison's pouch, vein of Galen, Aschoff body, Kell blood group, Down syndrome, Moro reflex, and Whipple procedure.

It is neither desirable nor indeed possible to completely avoid the use of eponyms in a health terminology. Nevertheless, FSNs should avoid including eponyms wherever possible in order to improve clarity of meaning and to facilitate translation to other languages. The full Description should be used as the FSN, and the eponymous term can be added as a synonym. For example, the FSN for “Moro reflex” should use the phrase “infant startle reflex.”

Exceptions are allowed when the full Description is exceptionally long and unwieldy. An example of allowed exception is “Hemi-Fontan operation (procedure).” This operation is defined as a “bidirectional Glenn shunt with end-to-side anastomosis of proximal superior vena cava to right pulmonary artery with isolation from right atrium”. The resulting FSN would be too long and unwieldy, so the eponym is allowed in the FSN in this case. Such exceptions require careful attention to the possibility that the eponym’s meaning may change over time.

Exceptions are also allowed for concepts where the eponym is the only precise clinically relevant name available, and where an artificially constructed non-eponymous name would necessarily be vague or subject to significant misinterpretation. Examples include “Hodgkin lymphoma” and “Burkitt lymphoma.”
It is permitted and encouraged to include eponyms as designations (non-FSN terms) whenever they are understandable, reproducible and useful in a given context. For example, the preferred term for “infant startle reflex” may be “Moro reflex.”

6.2.1.4.4.7.2 Proprietary names

Proprietary names are the proper names that have been assigned to products, usually drugs and devices, by their corporate producers. It is both necessary and useful to include proprietary names in a health terminology, subject to the following criteria:

1. Proprietary names belong in national extensions
   
   When needed in health terminology, the names and codes for proprietary products (drugs, devices, and other products including foods etc.) should be included in national extensions and not in the international release. This is not only because the same proprietary name may refer to an entirely different product in a different country, but also because there are differences in the process of production, including rules and regulations related to safety, packaging, labelling, and so forth, that make the meaning of proprietary product names dependent on the country or jurisdiction in which the product is approved for sale or distribution.

2. Exception for brand names that have become eponyms
   
   An exception may be made for brand names that have become eponyms. In this case, some brand names have come to stand for a category of product and not the particular brand itself. (Examples in US English include kleenex, band aid, coke, popsicle, jello, velcro, etc). These “proprietary eponyms” may be included in the international release as designations (non-FSN terms). Their FSNs should follow the rules for eponyms (above), and avoid the inclusion of the eponym in the FSN wherever possible. For example, the FSN for “jello” should use the phrase “fruit flavored gelatin”, and the FSN for “band aid” should use the phrase “plastic adhesive bandage strip”.

6.2.1.4.4.8 Hyphens and the word “of"

Hyphens should be avoided in FSNs, with rare exceptions. For example, the phrase “disability – all limbs” should be changed to say “disability of all limbs”. The rare exceptions occur in places such as the morphology hierarchy, where we need to distinguish categories from specific subtypes (see the editorial guidelines for the morphology hierarchy for explanation). In those circumstances, we may allow phrases such as “glioma – category” to differentiate the category term that includes all gliomas from a specific morphology of “glioma” as specified by ICD-O.

6.2.1.4.5 Process for adjudication (draft)

Assessment by submitters

Review by editorial staff

Rejections and deferrals appealed to Chief Terminologist, backup by Content Committee

Editorial staff will appeal both Rejections and Deferrals to the Chief Terminologist. For Rejections, there should be a way for the submitter to have a voice in the appeal process. Deferrals arise where the editorial staff needs clarity around modelling rules before proceeding (e.g. “in remission”). Resolution of deferrals may require an issue document, committee discussion, management board decision, etc. Simpler issues can hopefully be resolved more expeditiously – e.g. by a ruling of the Chief Terminologist, subject to being challenged by the Content Committee.

Principles, process and rules to be approved by Management Board

6.2.1.5 Pharmaceutical and Biologic Products Boundary and Scope for the International Release

6.2.1.5.1 Pharmacy Boundary and Scope Definition

The conclusion of the IHTSDO Management Board statement on medicines terminology reads as follows:

SNOMED CT will improve and support its terminology for medicines and pharmaceuticals in order to:

- Be genuinely useful and used in delivering better health care to people;
- Support the representation of drugs, with a perspective close to the patient.
The views and thinking articulated in this statement have been reflected in a number of projects. In particular, there was work that produced three documents outlining a proposed boundary for the “Pharmaceutical and Biological Products” Hierarchy in the International Release of SNOMED CT vs. National Extension Content. These documents were produced by the Pharmacy SIG.

Part 1 details the scope of the Pharmaceutical and Biological products hierarchy in the international release. Part 2 provides a data model, and Part 3 outlines editorial rules and style guidance.

6.2.1.5.2 Pharmaceuticals and Biologics Scope: Use Cases

In deciding where the boundary should be between the International Release of SNOMED CT and national extension, it is necessary to consider the purpose of SNOMED CT as a terminology. The conclusion of the Management Board statement on medicines terminology reads as follows:

**SNOMED CT will improve and support its terminology for medicines and pharmaceuticals in order to:**

- Be genuinely useful and used in delivering better health care to people;
- Support the representation of drugs, with a perspective close to the patient.

To further clarify this:

**The use cases for the International Release (in priority order):**

- being the foundation for the National releases (ease of linkage to the National releases)
- names, concept identifiers, and Relationships as a foundation to allow linking of the 3rd party Decision Support tools such as interaction checking to the International Release and therefore all National releases (definition still under discussion)
- International semantic interoperability:
  - Exchange of inferred (“generic”) information to support the electronic health record across national boundaries (medication list or allergies list), (definition still under discussion)

**The use cases for the National release:**

- National release would support the point of care applications
- National semantic interoperability:
  - prescribing (e.g. the prescribing of a medication which includes prescription and drug chart)
  - dispensing (e.g. the supply for consumption)
  - administration (e.g. the use of the medicine)
  - recording as part of the electronic health record (medication list or allergies list)

**Note.** It is recognised that National release centres may have additional use cases that require to be supported. It is however their responsibility to ensure that their National release is able to support these.

6.2.1.5.3 Pharmaceuticals and Biologics: Boundary assumptions

In defining the boundary for SNOMED CT International Release, we should achieve the following:

6.2.1.5.3.1 A "Risk managed" Terminology

SNOMED CT hierarchies are built using an IS_A Relationship so any Relationships stating that a concept has an IS_A to another concept must be true on an International arena.

The World Health Organisation, British Pharmacopoeial Commission and other national regulatory authorities have been working towards standardising the names used for medicinal substances. In order to be certain that an International Release concept as described has consistent meaning in the international arena concepts should seek to use INN where possible or other internationally recognised naming convention for the fully specified name.

Trademarks or brand names may be established by usage in the market place but more commonly nowadays are registered with the relevant registry or trademarks office. Since the legal right to usage is limited by the jurisdiction of the registering authority it is possible for a single brand name to be used in several nations to represent products which may or may not be similar.

For this reason the International Release should not contain any concepts that refer to a brand name whether as part of the moiety name or as the dose form.
6.2.1.5.3.2 A terminology that is Manageable / Maintainable

To achieve a terminology which is manageable and maintainable, it is necessary to consider to what level of concept granularity the International Release should go. Whilst it is preferable to provide a level of granularity that allows maximal decision support to function, the overhead cost of maintenance needs to be considered. It is also important that combinatorial explosion is avoided where clinically appropriate.

6.2.1.5.3.3 A level of granularity at the lowest level that is useful for international semantic interoperability

The SNOMED CT International Release should contain concepts of a level of granularity to allow portability of a clinically useful medication record from one country to another including those where similar branded products may not be available. This is judged to be DRUG-STRENGTH-FORM and represented by the NPMP concept class. For further information on the SNOMED CT International Release please see the document Pharmacy Boundary and Scope Part 2.

6.2.1.5.3.4 A level of granularity at the achievable level that is useful for decision support

NOTE: for the purpose of the pharmaceutical and biologic product boundary and scope work, "decision support" means:

- Interaction checking
- Contraindication checking
- Dosage checking
- Label text for patients
- Allergy / intolerance checking
- Therapeutic duplication

For decision support to be active it is necessary to clearly identify the active moiety. For most decision support in relation to dosage and indications, route of administration is required. Route of administration is often not easy to determine at a terminology level as the licenced route of administration may vary by legal right, and usage is limited by the jurisdiction of the licensing authority. Additionally in some settings the clinicians may choose to use a non licenced route of administration. It is often more appropriate to use dose form in decision support, in particular to identify suitable dosing increments, and may also have some bearing on suitable routes for administration or dosage.

Pack size may impact on decision support such as compliance however its use is limited and the overhead in maintaining all the internationally available pack sizes may be large.

Decision support requires the identification of medicines to apply decision support to current and future therapeutic decisions to ensure safety and quality of care. A basic level of decision support is based on contraindications, potential side effects and drug-drug interactions. This can be operated using the drug, moiety or Medicinal Entity concept. However more sophisticated decision support requires knowledge of route of administration in order to provide guidance around dosage and in some cases contraindications and side effects. A concept of at least moiety + route would be necessary to provide this.

A greater level of decision support relating the previous or current medication history could be achieved by providing a concept that gave indication drug, strength and route. Populating this runs the risk of terminological explosion as all potential combinations of drug + dose + route would need to be populated. Although the Relationship between form and route is not an absolute many-to-one match, for most drug forms the route is implicit. The provision of a concept of drug + dose + form would provide a pragmatic solution since only those known to be available internationally would need to be populated. However this would also have the benefit of allowing sufficient granularity for effective decision support.

6.2.1.5.3.5 A point at which existing terminologies can link to SNOMED CT

It is anticipated that national terminologies would wish to link to SNOMED CT International Release at a number of potential concept levels within the pharmaceutical and biological product hierarchy.

We envisage that there may be two ways of achieving this objective by:

- using the SNOMED CT International Release concepts within national extensions
- mapping the relevant national code set to the **SNOMED CT International Release concepts** when required.

Examples of existing terminologies that may use **SNOMED CT** include:

- Australia’s AMT will replace MP and MPUU which are equivalent to the moiety and the single unit dose form with **International Release concepts**. It should be noted that not all AMT MP and MPUU concepts will have equivalents in the **International Release** however those that are not equivalent will link using an **IS_A Relationship** to a core concept.

- UK’s dm+d links VTM and VMP which are equivalent to the moiety and the single unit dose form which are **SNOMED CT International Release concepts**. It should be noted that not all dm+d VTM and VMP concepts will have equivalents in the **International Release** however those that are not equivalent will link using an **IS_A Relationship** to a core concept.

- US’s RxNorm links semantic clinical drug (drug + strength + dose form). Other concept classes that could link to **International Release** are semantic clinical drug form (drug + dose form) and semantic clinical drug component (drug + strength) At present the editorial policy for products in **SNOMED CT International Release** does not support linking for the last two concept classes although there are some instances where a concept of the format drug + dose form have been created.

- Netherlands’ G standard can link the ‘substance’ which is equivalent to the moiety and moiety + salts/water for hydration **SNOMED CT International Release concepts**. In addition Netherlands’ G standard concept class of ‘Generic Product Characteristics’ (GPK) which equivalent to the proposed NPMP of the **SNOMED CT International Release concepts**.

6.2.1.5.3.6 Support for historical data in records

Medicines that are no longer used in current therapeutics still have a place in decision support, the recording of medical history, previous adverse reactions or the recording and notification of sensitivities. Retirement of concepts in **SNOMED CT** means removal from the hierarchy and removal of all Relationships such as HAS_ACTIVE_INGREDIENT. If this is actioned then in order for a concept to be used for decision support it would be necessary to utilise a concept history mechanism that contains all the required data elements. The current **SNOMED CT concept history mechanism** does not retain Relationship information (such as HAS_ACTIVE_INGREDIENT) and so would be inadequate. The additional issue of the need to identify concept history resulting from correction as opposed to history resulting from cessation of availability of a product would also need to be addressed. Therefore it is proposed that concepts describing medicines that are no longer current therapeutics should not be retired routinely provided they are, or were, valid concepts.

6.2.1.5.3.7 Timely population of agreed concepts

Timely population of **International Release concepts** is a significant issue for usefulness of the terminology. For other parts of the hierarchy a new concept is added when two or more IHTSDO member nations request this addition. This method of population is unlikely to be sufficiently responsive for the population of this part of the hierarchy. It is proposed that when a medicinal product is licenced within one of the member nations it can be proposed for inclusion within the **International Release**. Unlicensed medications and other edge cases would be included as defined in the paper describing the scope of products to be included in the hierarchy.

6.2.1.5.4 Pharmaceuticals and Biologics: Definitions and Boundaries

6.2.1.5.4.1 What is a Medicine?

**Definition (as per EU directive)**

“Any substance or combination of substances being presented as having properties for treating or preventing disease in human beings;

Any substance or combination of substances which may be used in or administered to human beings either with a view to restoring, correcting or modifying physiological functions by exerting a pharmacological, immunological or metabolic action, or to making a medical diagnosis.”

Article 1 of Directive 2001/83/EC

6.2.1.5.4.2 Boundaries and Scope for Medicinal Products

Using the above definition taken from the EU as the starting point, the scope for inclusion in the **SNOMED CT International Release** of the Pharmaceutical and Biological products hierarchy should
primarily aim to only include licenced medicinal products. However, it is noted that many boundary issues exist. Below is more information provided to further describe the boundaries to be applied to concepts for inclusion in the *International Release* in relation to product types.

- **Licensed vs. unlicensed**
- **Health supplements and OTC medicines**
- **Nutritional Products**
- **Homoeopathic Medicines**
- **Herbal Products**
- **Medical Devices**
- **Nanotechnology products**
- **Cosmetics and Toiletries**
- **Single component vs multi-component packs**

Additionally there are items that require more information on how to be handled or excluded *Drugs, Biologics and other products not yet ruled in or out of scope* on page 237:

- Human derived therapeutic products
- Dental products
- Monoclonal antibodies
- Ingredients for extemporaneously dispensed products.

### 6.2.1.5.4.2.1 Licenced Medicines

Licenced medicines and supporting data can be submitted by *IHTSDO Members* for inclusion. A medicine would need to be licenced in at least one *IHTSDO Member* nation and include a definitive strength.

The medicines to be included as the highest priority are those that could be added to a patient medication profile if they have been prescribed, dispensed and/or administered.

It was noted that many specialist systems and processes that have medicines use information within them that may not be connected to a medication profile application and therefore may be a lower priority for inclusion but are in scope; for example:

- Vaccination – this is often seen as a procedure, with the medicinal product used being recorded as part of the procedure e.g. a 67308009 | yellow fever vaccination (procedure) | actually involved the administration of the yellow fever vaccine product, but this latter does not get recorded.
- Anaesthetics – these and other supporting medications given during surgery are often recorded in specialist systems and not (yet) “shared” with medication profile applications. Note that medications administered during day case surgery would also fall into this category.
- X-ray contrast media and other diagnostic agents – these often highly allergenic products are often used in isolation and again recorded in specialist systems (which may still be paper-based) and the information does not find its way to a medication profile.
- Orphan drug products: these are licenced products intended for use in conditions where the patient population is likely to be very small, such as for rare diseases, resulting in lack of commercial development of the drug product due to limited revenue potential for the manufacturer. In some realms, the licensing process is modified to make it easier to gain marketing approval for drugs with "orphan" status.

### 6.2.1.5.4.2.2 Unlicensed Medicines

Unlicensed medicines may be included in the *International Release* only where good data can be provided and is agreed upon by two *IHTSDO Member* nations. This must include a definitive strength. However, unlicensed medicinal products are not routinely included in the *International Release* but rather should be included in national extensions. This includes medicines which are part of a Clinical Trial which should not be included in the *International Release* but are a national extension issue.
6.2.1.5.4.3 Boundaries and scope for additional products

6.2.1.5.4.3.1 Health Supplements and OTC Medicines

**Definition (as per EU directive)**

OTC = “over the counter” medicines; those sold directly to patients or the public either from a pharmacy or in a non-healthcare environment without the requirement for a prescription.

For the purposes of this document, health supplement and OTC medicines are defined as being those products that are **ONLY** intended as preparations for sale directly to the public without the requirement for a prescription.

These are ruled out of scope for the *International Release* and if required by a release centre should be added to a national extension.

6.2.1.5.4.3.2 Foods, Food Supplements, and Nutritional Products

**Foods**

**Definition (as per EU directive)**

“**Food (or foodstuff)** means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans…


Foods, generally, then are NOT medicinal products, and can be distinguished from medicinal products on the grounds of being identified as products which the average consumer would regard as something to be eaten, drunk or chewed as part of his/her diet.

It is anticipated that food concepts would not be included in patient’s medication records as a matter of course and therefore any decision support available would be limited. N.B. Allergy recording could be supported by the use of the Substance hierarchy in SNOMED CT.

**Scope for foods:**

These are ruled out of scope for the *SNOMED CT International Release* pharmaceutical and biologics hierarchy unless they are licenced products and specific medicinal claims are made for their use. It is anticipated that allergies to such products would be recorded using concepts from the Substances hierarchy. Decision support is not generally utilised for foodstuffs. If they are required by a National release centre the concepts should be added to the national extension.

**Food supplement**

**Definition (as per EU directive)**

“foodstuffs, the purpose of which is to supplement the normal diet and which are concentrated sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination, marketed in dose form”

Food supplements are concentrated sources of nutrients or other substances with a nutritional or physiological effect whose purpose is to supplement the normal diet. They are marketed 'in dose' form i.e. as pills, tablets, capsules, liquids in measured doses etc.

**Scope for food supplements:**

These are ruled out of scope for the *SNOMED CT International Release* pharmaceutical and biologics hierarchy unless they are licenced products and specific medicinal claims are made for their use. It is anticipated that allergies to such products would be recorded using concepts from the Substances hierarchy. Decision support is not generally utilised for food supplements. If they are required by a National release centre the concepts should be added to the national extension.

**Dietary foods for special medical purposes**

**Definition (as per EU directive)**

Foods used in patients with specific intolerance conditions (e.g. lactose free foods) or foods for patients with gluten sensitive enteropathies, such as coeliac disease (“gluten-free foods”), and low protein foods for patients suffering from inherited metabolic disorders, renal or liver failure requiring a low-protein diet.

In addition there are food products that seek to provide nutritional support to athletes and persons engaged in significant exercise (sports supplements) as well as slimming and dieting products. They fall within the definition of a medicinal product if they make medicinal claims or if they modify physiological functions by acting pharmacologically, immunologically or metabolically, or are marketed and used with a view to having such an effect.

**Scope for dietary foods for special medical purposes:**

These are ruled out of scope for the SNOMED CT International Release pharmaceutical and biologics hierarchy unless they are licenced products and specific medicinal claims are made for their use and there is sufficient data available to allow the IHTSDO support organisation to fully model. It is anticipated that allergies to such products would be recorded using concepts from the Substances hierarchy. Decision support is not generally utilised for such foods. If they are required by a National release centre the concepts should be added to the national extension.

6.2.1.5.4.3.3 Homeopathic Medicines

**Definition (as per EU definition)**

**Homoeopathic medicinal product Definition**

*Any medicinal product prepared from substances called homoeopathic stocks in accordance with a homoeopathic manufacturing procedure described by the European Pharmacopoeia or, in the absence thereof, by the pharmacopoeias currently used officially in the Member States. A homoeopathic medicinal product may contain a number of principles.*

*Article 1(5) of Directive 2001/83/EC, as amended by 2004/27/EC*

**Scope for homeopathic medicines**

These are ruled out of scope for the SNOMED CT International Release. If at some point in the future these were to be brought into scope it is anticipated that they would need to be modelled in a new section of SNOMED CT and would require a separate project to consider.

6.2.1.5.4.3.4 Herbal Products

**Definition**

*“Herbal Drug Preparations are obtained by subjecting herbal drugs to treatments such as extraction, distillation, expression, fractionation, purification, concentration or fermentation. These include comminuted or powdered herbal drugs, tinctures extracts, essential oils, expressed juices and processed exudates.” (European Pharmacopoeia)*

Herbal products typically contain a mix of compounds and it is often difficult to identify which are the therapeutically relevant ones. In addition since these products are usually unlicensed it is often not possible to access information giving details of the compounds and the amounts present. Because of this lack of information decision support for these products is limited and the information required to represent them in the terminology may not be available.

**Scope for herbal products**

These are ruled out of scope for the SNOMED CT International Release unless they are licenced products and specific medicinal claims are made for their use, and there is sufficient data available to allow the IHTSDO support organisation to fully model. If at some point in the future these were to be brought into scope it is anticipated that they would need a separate project to consider.

If these products are required to be represented in the terminology by a National release centre the concepts should be added to the national extension.

It is anticipated that allergies to such products would be recorded using concepts from the Substances hierarchy. For this reason, substance concepts that would be used in herbal medicines should continue to be included in the International Release within the Substance hierarchy.

6.2.1.5.4.3.5 Medical Devices

**A medical device**
Definition (as per EU definition)

“any instrument, apparatus, appliance, material or other article, whether used alone or in combination, including the software necessary for its proper application intended by the manufacturer to be used for human beings for the purpose of:

- diagnosis, prevention, monitoring, treatment or alleviation of disease,
- diagnosis, monitoring, treatment, alleviation of or compensation for an injury or handicap,
- investigation, replacement or modification of the anatomy or of a physiological process,
- control of conception,

and which does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its function by such means”

In the case of a medical device, the principal intended action is typically fulfilled by physical means (including mechanical action, physical barrier, replacement of, or support to, organs or body functions). The action of a medicinal product is typically achieved by pharmacological, immunological or metabolic means; a substance administered for diagnostic purposes, even though it does not act in such ways, is also usually considered to be a medicinal product.

Scope of medical devices

These are out of scope of the pharmaceutical and biologics hierarchy and are to be modelled in a different section of SNOMED CT. They require a separate project to consider if changes are required. N.B. There is a separate proposal being developed from the UK NHS Connecting for Health with regard to a model for these items.

Products that Incorporate or Administer an “Ancillary” Medicine

Definition (as per EU definition)

Products that incorporate or are used to administer a drug, may be regulated as either medical devices or as medicinal products, depending on the principal intended function of the product and the method by which this action is achieved. There are three main types of medical device which incorporate or are used to administer a medicinal product:

1. Devices which are used to administer medicinal products: for example, a syringe marketed empty, medicine spoons, droppers etc. This category also includes devices which can be refilled with further doses of medication contained within the same pack as the medicine. All of these products are covered by the Medical Devices Regulations. If they are included separately in a pack with the medicine they will still need to comply with the MDR, including labelling provisions.

2. Devices for administering medicinal products where the device and the medicinal product form a single integral product designed to be used exclusively in the given combination and which are not re-usable or re-fillable: For example a syringe marketed pre-filled. These products are covered by medicines legislation, although in addition to this, the relevant essential requirements in Annex 1 of the Medical Devices Directive 93/42/EEC apply with respect to safety and performance related features of the device (e.g. a syringe forming part of such a product).

3. Devices incorporating, as an integral part, a substance, which, if used separately, may be considered to be a medicinal product and which is such that the substance is liable to act upon the body with action ancillary to that of the device: For example a heparin coated catheter. These products are subject to the MDR*. In addition, the safety, quality and usefulness of the medicinal substance must be verified by analogy with the methods required in Directive 2001/83/EC concerning the testing of proprietary medicinal products. Under the classification rules set out in the Medical Devices Directive (see Bulletin Number 10); such a device would fall into class III under rule 13. The Notified Body carrying out relevant conformity assessment procedures in respect of such a device must consult a Member State competent authority for medicinal products or the EMA where appropriate on the medicinal aspects of the device. Note that in the MHRA’s opinion 'integral' means a single component product (e.g. such as coated or incorporated within) rather than a pack containing the two components (i.e. a drug and a device).

Scope of products that incorporate or administer an ancillary medicine

Items that are considered to be administered products are within scope. Products that fall into these categories include:
• Dialysis fluids including Peritoneal dialysis solutions, including those for CAPD, Haemodialysis solutions, Haemofiltration solutions and iontophoresis solutions

• Ophthalmic Products including
  • Contact lens care products
  • Unmedicated artificial tears
  • Fluorescein and Rose Bengal products
  • Ocular endotamponades and viscoelastic/viscosurgical products
  • Ophthalmic irrigation solutions

• Non-medicated dermatological creams
• Irrigation solutions
• Viscoelastic gels for joint lubrication
• IUDs with a hormone action, and spermicidal preparations – creams, pessaries and sponges/films where the primary purpose is as a drug delivery system are all medicinal products.

All other device items are considered out of scope of the pharmaceutical and biological product hierarchy and should be modelled as devices. There are devices that incorporate a drug substance but do not deliver a specific amount of that drug either in total or as a rate of release; these include

• stents incorporating anticoagulant or anti-thrombotic medication (gelatin, heparin, proteins)
• bone cements incorporating antibiotics
• devices with bacteriological coatings (chlorhexidine, benzalkonium chloride, silver, antibiotics)

Other items considered out of scope include:

• Medicated dressings. Most surgical dressings are devices, unless they are medicated and are making a “medicinal” claim; bandages are medicines only if the therapeutic effect of their medication is their primary purpose.
• Disinfectants that are designed for use on objects rather than on or in living subjects are not be considered medicines.
• Sutures etc. are medical devices, but some biological sealants may be classed as medicines, particularly if their mechanism of action is pharmacological (e.g. working on the clotting cascade)
• Resorbable bone plates and hard tissue scaffolds (hydroxyapatite and calcium phosphate – both with and without collagen – bioglas, coral and cartilage repair systems) (including scaffolds used in dentistry) are usually medical devices unless they contain bioactive materials.
• Artificial skin systems that do not contain material of human origin will be medical devices (probably).
• Devices used to deliver anaesthetic products
• Medicinal gases are considered to be medicines, but the equipment used to administer them (or to make (e.g. oxygen concentrators or generators) or transport them (e.g. piping) is considered to be medical device.
• Contraceptive Products. Intrauterine devices (IUDs) without hormonal/pharmacological action, diaphragms and condoms (with or without spermicide) are medical devices.

* MDR – Medical Device Regulations

6.2.1.5.4.3.6 Nanotechnology Products

Definition

Nanotechnologies are the design, characterization, production and application of structures, devices and systems by controlling shape and size at nanometer scale.

(Royal Pharmaceutical Society of Great Britain definition, June 2004)

Nanomedicine is defined as the application of nanotechnology in view of making a medical diagnosis or treating or preventing diseases. It exploits the improved and often novel physical, chemical and biological properties of materials at nanometre scale (EMEA, June 2006).
The majority of current commercial applications of nanotechnology in medicine are geared towards drug delivery to enable new modes of action, as well as better targeting and bioavailability of existing medicinal substances. Novel applications of nanotechnology include nanostructure scaffolds for tissue replacement, nanostructures that allow transport across biological barriers, remote control of nanoprobes, integrated implantable sensory nanoelectronic systems and multifunctional chemical structures for drug delivery and targeting of disease.

At the moment there are no regulations specific to medicines or medical devices using nanotechnology, but it is a developing area and new products are likely in the coming years.

**Scope of nanotechnology products**

Products currently incorporating nanotechnologies are already available in member nations as licenced medicinal products. The use of these technologies can significantly affect the chemical and physical properties of the active ingredient and would impact on decision support for products containing them. These should be considered as in scope for inclusion in the **SNOMED CT International Release**.

**6.2.1.5.4.3.7 Cosmetics and Toiletries**

Cosmetics (products applied to the body, especially the face to improve its appearance – New Oxford English Dictionary) and toiletries (articles used in washing and taking care of one’s body, such as soap, shampoo and toothpaste - New Oxford English Dictionary) are generally not defined as medicines.

However, if any of these contain a pharmacologically active substance or to make medicinal claim, then they become “subject to medicines control” (e.g. a toothpaste making claims to treat or prevent ‘sensitive teeth’ becomes “a medicinal product”).

It is anticipated that cosmetics and toiletries concepts would not be included in patient’s medical records as a matter of course and therefore the use case for application of decision support available would be limited. N.B. Allergy recording could be supported by the use of the Substance hierarchy in **SNOMED CT**.

**Scope of cosmetics and toiletries**

These are ruled out of scope for the **SNOMED CT International Release** unless they are licenced products or specific medicinal claims are made for their use e.g. shampoo for lice treatments.

It is anticipated that allergies to such products would be recorded using concepts from the Substances hierarchy. Decision support does not generally consider cosmetics and toiletries.

**6.2.1.5.4.4 Drugs, Biologics and other products not yet ruled in or out of scope**

**Human derived therapeutic products including:**

- Soft tissue fillers (collagen and silicone elastomer dispersions) are medical devices, but if human tissue derived, they may be seen as medicinal products or may be part of the new “human derived therapeutic products” class.
- Human tissue products such as dura (mater) grafts, skin fibroblasts and bone tissue are either considered medicines, or are currently not regulated as “products” as such.

**Blood Products**

Currently, blood and blood products are found in the pharmaceutical/biological product hierarchy under the parent concept 410652009 | blood product (product) |. This includes autologous blood products.

Note: this does not include products manufactured from blood, such as albumin solutions and clotting factors; these are found elsewhere in the pharmaceutical/biological product hierarchy under the parent concept 346348003 | blood derivative product (product) |.

Note: Artificial plasma volume expanders are considered to be medicinal products.

N.B. Blood products are included in the scope of the UK project on devices.

**Dental Products**

- Sealants for fissures and root canal pits
- Root canal dressings, which usually contain antibiotics and/or antiseptics
- Pulp capping material and materials for dry socket preparation
Disclosing tablets and other in-vivo diagnostics
Haemostatic agents and astringents
Fluoride preparations – tablets, gels (toothpastes) and varnishes
Periodontal antibacterials – gels, ointments and fibres
Periodontal dressings
Antibacterial mouthwashes and gels
Medicated mouth ulcer preparations are medicines
Desensitising agents
Artificial saliva products are devices

The above are potentially a mixture of medicines and devices; input from dental professionals as to the use cases for dental product concepts would be required before decisions would be taken on how best to handle this area.

**Monoclonal antibodies**

Where there are available licenced medicinal products using this technology, those products are to be considered as in scope for the Pharmaceutical and Biological product hierarchy for the *SNOMED CT International Release*. Monoclonal antibodies may also be used as in-vitro diagnostics or as immunotoxins; currently these are not considered to be "products".

**Extemporaneously Dispensed Products**

Since these are in theory potentially infinite in their combinations, strengths and presentations they are not considered appropriate for addition to the *SNOMED CT International Release*. Where there are standard pharmacopoeial preparations or those endorsed by appropriate specialist organisations (for example Royal colleges) a National release Centre may decide to add these to their extension.

**Ingredients for Extemporaneously Dispensed Products**

Ingredients for extemporaneously dispensed medicines are likely to be “products” in their own right (e.g. raspberry syrup, chloroform spirit). Products such as these are currently located as children of 43747001 | drug excipient (product) | in the pharmaceutical/biological product hierarchy. This may not be strictly appropriate, and this should be reviewed.

There may be some cases where there is a requirement to use a “substance” concept to describe an ingredient within an extemporaneous preparation.

**Leeches and Maggots**

Those that are supplied commercially are generally accepted as being medicinal products when intended for medicinal use however at present are not subject to licensing as medicinal products. Without the licensing requirements it may be difficult to access sufficient information to allow the support organisation to add these concepts. In addition it would appear that the decision support available to guide the use of these products is limited at this time.

Whilst the concept 410969008 | sterile maggots (product) | is present in the pharmaceutical/biological product hierarchy and there is the concept 8181006 | maggot (organism) | in the organism hierarchy, currently leeches are concepts in the organism hierarchy only.

It is recommended that a decision as to whether these and other similar biological entities are considered for inclusion in this hierarchy is pended until further information is available and may require an additional project to define editorial rules and an appropriate model for such concepts.

**6.2.1.5.5 Pharmaceuticals and Biologics: International Release Model**

**6.2.1.5.5.1 Model Overview**

The data representation is based on *SNOMED CT*. As noted previously, *SNOMED CT* is a comprehensive and precise clinical reference terminology. It provides a comprehensive list of clinical terms and identifiers that allows complex clinical concepts to be described in a way that computers can interpret.

Building the terminology in this manner provides:

**Descriptions**: Defined using the standard *SNOMED CT Description* types - that is ‘Fully Specified Name’ and a preferred term [1] will be added for the *International Release*
**Relationships:** Each concept will have a SNOMED CT defined Relationship to an appropriate super type concept.

Inherited defining Relationships (where appropriate)

Specific defining Relationships and Relationships to other defined concepts;

Historical relationships.

[1] RF2 does not have a Description type value “Preferred Term”, only types of “Fully specified name” and “Synonym”, where the latter may be refined either to a “Preferred term” or to a “Synonym” within a language reference set. As a result of this change, in RF2 the preference for particular Descriptions in a language or dialect will be represented in the language reference set, and not in the description file.

6.2.1.5.5.2 Model Assumptions

- The National releases will handle multi-component packs and they are therefore excluded from the scope of the International Release. However, it is noted that the International Release must represent the individual active components of these packs. (Inert components of a multicomponent pack are expected to be the responsibility of the National release – this includes diluents and solvents.) For the purposes of this document a multi-component pack is defined as a pack that contains two or more separate components each of which is a virtual medicinal product or appliance concept (in the case of applicators) in its own right although it may not be available or prescribable alone.

N.B. investigation of how multi-component packs are handled by decision support knowledge vendors is required to ensure that this is a valid assumption to make.

- Dual representation of strength will be managed by terms included in the National release.

- The existing top hierarchy will be required to be removed in a manner that is consistent with the IS_A overload project undertaken by the allergies redesign working group. See Revision of upper levels on page 240.

- Modified preparations. Since no phamacopoeial standards exist for modified release dose forms, the intended duration of action should not be identified for concepts in the International Release. Should a member nation wish to create concepts indicating duration (for example, Morphine 10mg 12-hour modified release capsules), these would be managed by the national extension. This means that in the SNOMED CT International Release, modified release preparations (for example, the NPMP ‘Morphine 10mg modified release capsules’) would be identified with no reference to duration of action.

- It is recognised that implementations may have a requirement for a term that has fewer characters than the Fully Specified Name. However since terms containing abbreviations should not be part of the International Release these synonyms will be the responsibility of the National release Centre and contained in their national extension.

- For countries without a National Release Centre it is anticipated that they will utilise another country’s National Extension as their drug dictionary since the International Release is unlikely to provide all the concepts and terms required to support prescribing.

- There is a requirement for further specification of issues relating to Dose Forms including:
  - How Form and Strength are represented e.g. where units are used to describe strength, does it need to be explicitly stated what flavour of units is being used?
  - How to identify and work with appropriate standards to harmonise content, for example HL7 and the European Directorate for the Quality of Medicines (EDQM), ISO and others.
  - How to define new therapeutic forms as required.
  - How to represent dual chamber medicinal products e.g. Coverlet

- For a Non-proprietary Medicinal Preparation concept to be eligible for inclusion in the SNOMED CT International Release, it should be licenced in a member nation. Monitoring lists of newly licenced entities can facilitate a more proactive population of the Pharmaceutical and Biological product hierarchy.

- Valid Concepts relating to medicinal products that are no longer available internationally should still remain within the hierarchy. This is because the concept may be part of a medical record as previous medical history and would still have value provided its existing Relationships and attributes are preserved.
6.2.1.5.5.3 Revision of upper levels

*IS_A* overloading in the Pharmaceutical and Biological Product hierarchy causes problems with inappropriate inheritance of information. The top levels of this hierarchy – all those above the Medicinal Entity class - should be removed to eliminate inappropriate inheritance in *SNOMED CT*.

The multiple *Relationships* at the upper levels of this hierarchy cause problems for implementers particularly where therapeutic agents have more than one potential use. Timolol, Aspirin, Glycerin, Prednisolone products are some of the concepts affected by this problem of multiple indications.

For example it is currently possible by navigating the *IS_A Relationships* to infer that 407802008 | timolol 0.1% liquid eye gel (product) | *IS_A* 1182007 | hypotensive agent (product) |

This occurs because the parent concept 422023000 | ophthalmic form timolol (product) | has three parent concepts:

404635006 | beta blocker glaucoma preparation (product) |
440130005 | ocular dosage form product (product) |
85591001 | timolol (product) |

Figure 57: Timolol Supertypes

All of these are reasonable for the concept 85591001 | timolol (product) | but this *IS_A Relationship* is not always true as the *Relationships* are inherited further down the hierarchy, as | timolol 0.1% liquid eye gel | inherits the | cardiovascular drug | concept through its | timolol (product) | parent.

The plan is to eliminate this type of error by removing / relocating the upper levels of the hierarchy (any concepts above the Medicinal Entity or Medicinal Entity with Modifier level).

It is estimated that this will involve the review and relocation / retirement of approximately 6,000 concepts.

Although it is not anticipated that these upper level “therapeutic classification” type concepts would be used directly for prescribing, they do have a variety of uses, which include:

- formulary management and pharmaco-epidemiology
• medication statement – for example “patient taking NSAID” (exact medicine unknown); used in pharmacovigilance and in emergency care
• various types of querying – for example:
  • decision support – “contra-indicated in patient using a beta-blocker”
• audit – “find all patients using beta-agonists”
• navigation of medicinal product information

These removed / relocated concepts would be placed in a separate part of the pharmaceutical and biological product hierarchy and could then be associated with the main pharmaceutical and biological product hierarchy concepts by a role based Relationship rather than an IS_A Relationship.

A separate part of the pharmaceutical and biological product hierarchy is to be created under a parent concept of Therapeutic product group (product).

This will be a flatter hierarchy and will contain concepts denoting mode of action or chemical structure without specific indications for use.

Examples of such concepts are:
33252009 | beta-Blocking agent (product) |
83522001 | non-selective beta-blocking agent (product) |
427804001 | chemokine receptor antagonist (product) |
32249005 | antiviral agent (product) |

New concept - Osmotic agent (product) – a replacement for the concept of 317573002 | osmotic laxatives | that would be retired.

These concepts will be associated with the Medicinal Entity or Medicinal Entity with Modifier concept class by a new Relationship of ‘plays therapeutic role’. One Medicinal Entity or Medicinal Entity with Modifier concept may have none to many ‘plays therapeutic role’ Relationships dependent upon whether it has multiple modes of action or if the mode of action is not known.

Concepts from this top level of the pharmaceutical and biological product hierarchy that do not fit with the new editorial guidance, and which therefore have no Relationship to any ME or ME with modifier will be retired.

Examples of concepts that it is anticipated will be retired are:
Those that indicate a specific indication, e.g.:
413969007 | dental disclosing preparation (product) |
404635006 | beta blocker glaucoma preparation (product) |
61621000 | laxative (product) |

Those that provide general groupings too non-specific to be useful:
350074002 | chelating agents and antidotes (product) |
105924008 | laxative, cathartic AND/OR purgative (product) |

Those denoting the body system that the medicinal entity acts upon:
350060009 | drug groups primarily affecting the musculoskeletal system (product) |
14833006 | cardiovascular drug (product) |
39741008 | gastrointestinal drug (product) |

It is important to note that the removal of these therapeutic “grouper” concepts from the hierarchy would result in there being a large number of concepts as direct children of the concept 373873005 | pharmaceutical / biologic product (product) |. It is expected this will be in the region of 5,000-10,000 concepts. This may make the operation of some browsers difficult but is seen as essential to remove inappropriate inheritance. It may be that some implementations might choose to use the new grouper concept structure as an aid to navigation and display of this hierarchy in browsers, which would overcome this problem. However, it should be noted that in normal clinical practise the medicinal concepts themselves
(ME, ME with modifier and NPMP) are usually accessed by direct alpha-numeric search, not through browsing a hierarchy, so the removal of large numbers of grouper concepts is not expected to cause issues to most non-browser-based implementations.

### 6.2.1.5.6 Pharmaceuticals and Biologics Boundary and Scope: Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>AMT</td>
<td>Australian Medicines Terminology</td>
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<tr>
<td>dm+d</td>
<td>Dictionary of Medicines and Devices (UK)</td>
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<tr>
<td>EMA</td>
<td>European Medicines Agency</td>
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<tr>
<td>FSN</td>
<td>Fully Specified Name</td>
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<tr>
<td>IHTSDO</td>
<td>International Health Terminology Standards Development Organisation</td>
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<tr>
<td>INN</td>
<td>International Non-proprietary Name</td>
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<tr>
<td>ME</td>
<td>Medicinal Entity</td>
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<tr>
<td>MHRA</td>
<td>Medicines and Healthcare Products Regulatory Authority (UK)</td>
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<tr>
<td>MP</td>
<td>Medicinal Product</td>
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<tr>
<td>MPUU</td>
<td>Medicinal Product Unit of Use</td>
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<tr>
<td>NHS</td>
<td>National Health Service (UK)</td>
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<tr>
<td>NPMP</td>
<td>Non-Proprietary Medicinal Preparation</td>
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<td>OTC</td>
<td>Over the Counter</td>
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<tr>
<td>RF2</td>
<td>SNOMED CT Release Format 2</td>
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<td>SNOMED CT®</td>
<td>SNOMED Clinical Terms</td>
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<tr>
<td>VTM</td>
<td>Virtual Therapeutic Moiety</td>
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<tr>
<td>VMP</td>
<td>Virtual Medicinal Product</td>
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</table>

### 6.2.2 Attributes Used in SNOMED CT

This part of the guide provides an overview of the defining attributes used by the SNOMED CT Concept Model. Further details are provided in the chapters dedicated to each hierarchy.

#### 6.2.2.1 Summary of attribute domains and ranges

#### 6.2.2.1.1 Defining Attributes by Hierarchy and Domain

The following table lists the top-level hierarchies for which there are defining attributes. Not all hierarchies in SNOMED CT have defining attributes. They were developed in the priority
areas first. The highest priority was to develop defining attributes that would be useful for aggregated analysis of outcomes, decision support, knowledge-based practise guidelines, etc. in a clinical setting. Therefore, defining attributes in SNOMED CT were first assigned to those hierarchies where retrieval of clinical data is most useful and relevant: procedure, finding, and situation with explicit context. Concepts in other hierarchies can be primitives and still serve as the values of attributes for the concept definitions of the main hierarchies.

Some domains are not top-level hierarchies, and some top-level hierarchies are not domains. Each item in the Hierarchy column refers to the top-level hierarchy where the attribute applies. Some of these do not actually apply at the very top of the hierarchy, but are restricted to a domain defined lower down. Some of them apply to more than one top-level hierarchy. Each item in the Attribute column refers to a single attribute that resides in the Attribute hierarchy.

Table 101: Defining Attributes by Top-Level Hierarchy

<table>
<thead>
<tr>
<th>HIERARCHY</th>
<th>ATTRIBUTE</th>
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<tbody>
<tr>
<td>Body structure</td>
<td>Laterality</td>
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<td>Clinical finding</td>
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<td>Associated morphology</td>
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<td>Causative agent</td>
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<td>Finding informer</td>
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<td>Interprets</td>
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<td>Situation with explicit context</td>
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<td>ATTRIBUTE</td>
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<td>Access</td>
</tr>
<tr>
<td></td>
<td>Component</td>
</tr>
<tr>
<td></td>
<td>Direct device</td>
</tr>
<tr>
<td></td>
<td>Direct morphology</td>
</tr>
<tr>
<td></td>
<td>Direct substance</td>
</tr>
<tr>
<td></td>
<td>Has focus</td>
</tr>
<tr>
<td></td>
<td>Has intent</td>
</tr>
<tr>
<td></td>
<td>Has specimen</td>
</tr>
<tr>
<td></td>
<td>Indirect device</td>
</tr>
<tr>
<td></td>
<td>Indirect morphology</td>
</tr>
<tr>
<td></td>
<td>Measurement method</td>
</tr>
<tr>
<td></td>
<td>Method</td>
</tr>
<tr>
<td></td>
<td>Priority</td>
</tr>
<tr>
<td></td>
<td>Procedure device</td>
</tr>
<tr>
<td></td>
<td>Procedure morphology</td>
</tr>
<tr>
<td></td>
<td>Procedure site</td>
</tr>
<tr>
<td></td>
<td>Procedure site - Direct</td>
</tr>
<tr>
<td></td>
<td>Procedure site - Indirect</td>
</tr>
<tr>
<td></td>
<td>Property</td>
</tr>
<tr>
<td></td>
<td>Recipient category</td>
</tr>
<tr>
<td></td>
<td>Revision status</td>
</tr>
<tr>
<td></td>
<td>Route of administration</td>
</tr>
<tr>
<td></td>
<td>Scale type</td>
</tr>
<tr>
<td></td>
<td>Surgical Approach</td>
</tr>
<tr>
<td></td>
<td>Time aspect</td>
</tr>
<tr>
<td>HIERARCHY</td>
<td>ATTRIBUTE</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Specimen</td>
<td>Specimen procedure</td>
</tr>
<tr>
<td></td>
<td>Specimen source identity</td>
</tr>
<tr>
<td></td>
<td>Specimen source morphology</td>
</tr>
<tr>
<td></td>
<td>Specimen source topography</td>
</tr>
<tr>
<td></td>
<td>Specimen substance</td>
</tr>
</tbody>
</table>

Table 102: Top-Level Hierarchies That Have No Defining Attributes

<table>
<thead>
<tr>
<th>HIERARCHY</th>
<th>ATTRIBUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
<td>none</td>
</tr>
<tr>
<td>Environments and geographical locations</td>
<td>none</td>
</tr>
<tr>
<td>Observable entity</td>
<td>see draft of new model</td>
</tr>
<tr>
<td>Organism</td>
<td>see draft of new model</td>
</tr>
<tr>
<td>Physical force</td>
<td>none</td>
</tr>
<tr>
<td>Qualifier value</td>
<td>none</td>
</tr>
<tr>
<td>Social context</td>
<td>none</td>
</tr>
<tr>
<td>Special concept</td>
<td>none</td>
</tr>
<tr>
<td>Staging and scales</td>
<td>none</td>
</tr>
<tr>
<td>Substance</td>
<td>see draft of new model</td>
</tr>
</tbody>
</table>

Each attribute has a specific domain to which it applies; in many cases these domains are simply the same as the top-level hierarchies, as listed in parentheses after the domain name. In other cases, there is a more restrictive domain. In the following table, the left-hand column names the specific domain, and the right hand column the defining attributes.
### Table 103: Allowed Attributes by Domain

<table>
<thead>
<tr>
<th>DOMAIN (HIERARCHY)</th>
<th>ATTRIBUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration of substance via specific route (procedure)</td>
<td></td>
</tr>
<tr>
<td>Anatomical structure (body structure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical finding (finding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Disorder (finding)</td>
<td></td>
</tr>
<tr>
<td>Drug delivery device (physical object)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10 This attribute is allowed only in close-to-user form. It is used for user-level composition, and is not applied directly as defining attributes in the distributed form (or in normal forms).
<table>
<thead>
<tr>
<th>DOMAIN (HIERARCHY)</th>
<th>ATTRIBUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation procedure (procedure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Event (event)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical / biologic product (product)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>DOMAIN (HIERARCHY)</th>
<th>ATTRIBUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure (procedure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Situation with explicit context (situation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding with explicit context (situation) - descendants only</td>
<td></td>
</tr>
</tbody>
</table>
Table 104: Historical Relationships by Domain

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>HISTORICAL REALATIONSHIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambiguous Concept</td>
<td>MAYBE A</td>
</tr>
<tr>
<td>Duplicate Concept</td>
<td>SAME AS</td>
</tr>
<tr>
<td>Erroneous Concept</td>
<td>REPLACED BY</td>
</tr>
<tr>
<td>WAS A</td>
<td></td>
</tr>
<tr>
<td>Inactive reason Not Stated Concept</td>
<td>REPLACED BY</td>
</tr>
<tr>
<td>WAS A</td>
<td></td>
</tr>
<tr>
<td>Limited Status Concept</td>
<td>WAS A</td>
</tr>
<tr>
<td>Moved From Elsewhere Concept</td>
<td>MOVED FROM</td>
</tr>
<tr>
<td>Moved To Elsewhere Concept</td>
<td>MOVED TO</td>
</tr>
<tr>
<td>Outdated Concept</td>
<td>REPLACED BY</td>
</tr>
<tr>
<td>WAS A</td>
<td></td>
</tr>
<tr>
<td>Pending Move Concept</td>
<td>MOVED TO</td>
</tr>
</tbody>
</table>
### 6.2.2.1.2 Allowable Ranges

The following table contains the allowable Values (Ranges) that can be applied to each Attribute. Note that each item in the Attribute column refers to a single concept that resides in the Attribute hierarchy.

**Table 105: Allowable Ranges for Concept Model Attributes**

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCESS</td>
<td>Surgical access values</td>
</tr>
<tr>
<td>AFTER</td>
<td>Clinical Finding</td>
</tr>
<tr>
<td>ASSOCIATED FINDING</td>
<td>Clinical finding</td>
</tr>
<tr>
<td>ASSOCIATED MORPHOLOGY</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>ASSOCIATED PROCEDURE</td>
<td>Procedure</td>
</tr>
<tr>
<td>ASSOCIATED WITH</td>
<td>Clinical Finding</td>
</tr>
<tr>
<td>CAUSATIVE AGENT</td>
<td>Organism</td>
</tr>
<tr>
<td>ATTRIBUTE</td>
<td>RANGE</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>COMPONENT</td>
<td>Substance</td>
</tr>
<tr>
<td></td>
<td>Observable entity</td>
</tr>
<tr>
<td></td>
<td>Cell structure</td>
</tr>
<tr>
<td></td>
<td>Organism</td>
</tr>
<tr>
<td>CLINICAL COURSE</td>
<td>Courses</td>
</tr>
<tr>
<td>DIRECT DEVICE</td>
<td>Device</td>
</tr>
<tr>
<td>DIRECT MORPHOLOGY</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>DIRECT SUBSTANCE</td>
<td>Substance</td>
</tr>
<tr>
<td></td>
<td>Pharmaceutical / biologic product</td>
</tr>
<tr>
<td>DUE TO</td>
<td>Clinical Finding</td>
</tr>
<tr>
<td></td>
<td>Event</td>
</tr>
<tr>
<td>EPISODICITY</td>
<td>Episodicities</td>
</tr>
<tr>
<td>FINDING CONTEXT</td>
<td>Finding context value</td>
</tr>
<tr>
<td>FINDING INFORMER</td>
<td>Performer of method</td>
</tr>
<tr>
<td></td>
<td>Subject of record or other provider of history</td>
</tr>
<tr>
<td>FINDING METHOD</td>
<td>Procedure</td>
</tr>
<tr>
<td>FINDING SITE</td>
<td>Anatomical or acquired body structure</td>
</tr>
<tr>
<td>HAS ACTIVE INGREDIENT</td>
<td>Substance</td>
</tr>
<tr>
<td>HAS DEFINITIONAL MANIFESTATION</td>
<td>Clinical finding</td>
</tr>
<tr>
<td>HAS DOSE FORM</td>
<td>Type of drug preparation</td>
</tr>
<tr>
<td>HAS FOCUS</td>
<td>Clinical finding</td>
</tr>
<tr>
<td></td>
<td>Procedure</td>
</tr>
<tr>
<td>HAS INTENT</td>
<td>Intents (nature of procedure values)</td>
</tr>
<tr>
<td>HAS INTERPRETATION</td>
<td>Findings values</td>
</tr>
<tr>
<td>HAS SPECIMEN</td>
<td>Specimen</td>
</tr>
<tr>
<td>ATTRIBUTE</td>
<td>RANGE</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>INDIRECT DEVICE</td>
<td>Device</td>
</tr>
<tr>
<td>INDIRECT MORPHOLOGY</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>INTERPRETS</td>
<td>Observable entity</td>
</tr>
<tr>
<td></td>
<td>Laboratory procedure</td>
</tr>
<tr>
<td></td>
<td>Evaluation procedure</td>
</tr>
<tr>
<td>LATERALITY</td>
<td>Side</td>
</tr>
<tr>
<td>MEASUREMENT METHOD</td>
<td>Laboratory procedure categorized by method</td>
</tr>
<tr>
<td>METHOD</td>
<td>Action</td>
</tr>
<tr>
<td>OCCURRENCE</td>
<td>Periods of life</td>
</tr>
<tr>
<td>PATHOLOGICAL PROCESS</td>
<td>Autoimmune</td>
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<td></td>
<td>Infectious process</td>
</tr>
<tr>
<td></td>
<td>Hypersensitivity process</td>
</tr>
<tr>
<td>PRIORITY</td>
<td>Priorities</td>
</tr>
<tr>
<td>PROCEDURE CONTEXT</td>
<td>Context values for actions</td>
</tr>
<tr>
<td>PROCEDURE DEVICE</td>
<td>Device</td>
</tr>
<tr>
<td>PROCEDURE MORPHOLOGY</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>Direct morphology</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>Indirect morphology</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>PROCEDURE SITE</td>
<td>Anatomical or acquired body structure</td>
</tr>
<tr>
<td>Procedure site - Direct</td>
<td>Anatomical or acquired body structure</td>
</tr>
<tr>
<td>Procedure site - Indirect</td>
<td>Anatomical or acquired body structure</td>
</tr>
<tr>
<td>PROPERTY</td>
<td>Property of measurement</td>
</tr>
<tr>
<td>ATTRIBUTE</td>
<td>RANGE</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>RECIPIENT CATEGORY</td>
<td>Person</td>
</tr>
<tr>
<td></td>
<td>Family</td>
</tr>
<tr>
<td></td>
<td>Community</td>
</tr>
<tr>
<td></td>
<td>Donor for medical or surgical procedure</td>
</tr>
<tr>
<td></td>
<td>Group</td>
</tr>
<tr>
<td>REVISION STATUS</td>
<td>Primary operation</td>
</tr>
<tr>
<td></td>
<td>Revision - value</td>
</tr>
<tr>
<td></td>
<td>Part of multistage procedure</td>
</tr>
<tr>
<td>ROUTE OF ADMINISTRATION</td>
<td>Route of administration value</td>
</tr>
<tr>
<td>SCALE TYPE</td>
<td>Quantitative</td>
</tr>
<tr>
<td></td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td>Ordinal value</td>
</tr>
<tr>
<td></td>
<td>Ordinal or quantitative value</td>
</tr>
<tr>
<td></td>
<td>Nominal value</td>
</tr>
<tr>
<td></td>
<td>Narrative value</td>
</tr>
<tr>
<td></td>
<td>Text value</td>
</tr>
<tr>
<td>SEVERITY</td>
<td>Severities</td>
</tr>
<tr>
<td>SPECIMEN PROCEDURE</td>
<td>Procedure</td>
</tr>
<tr>
<td>SPECIMEN SOURCE IDENTITY</td>
<td>Person</td>
</tr>
<tr>
<td></td>
<td>Family</td>
</tr>
<tr>
<td></td>
<td>Community</td>
</tr>
<tr>
<td></td>
<td>Device</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
</tr>
<tr>
<td>SPECIMEN SOURCE MORPHOLOGY</td>
<td>Morphologically abnormal structure</td>
</tr>
<tr>
<td>SPECIMEN SOURCE TOPOGRAPHY</td>
<td>Anatomical or acquired body structure</td>
</tr>
<tr>
<td>SPECIMEN SUBSTANCE</td>
<td>Substance</td>
</tr>
<tr>
<td>SUBJECT RELATIONSHIP CONTEXT</td>
<td>Person</td>
</tr>
<tr>
<td>SURGICAL APPROACH</td>
<td>Procedural approach</td>
</tr>
<tr>
<td>TEMPORAL CONTEXT</td>
<td>Temporal context value</td>
</tr>
<tr>
<td>ATTRIBUTE</td>
<td>RANGE</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>TIME ASPECT</td>
<td>Time frame</td>
</tr>
<tr>
<td>USING ACCESS DEVICE</td>
<td>Device</td>
</tr>
<tr>
<td>USING DEVICE</td>
<td>Device</td>
</tr>
<tr>
<td>USING ENERGY</td>
<td>Physical force</td>
</tr>
<tr>
<td>USING SUBSTANCE</td>
<td>Substance</td>
</tr>
</tbody>
</table>

Meaning of Allowable Values (Range) notations:

- (<<) this code and descendants,
- (>) descendants only,
- (<=) descendants only (stated) except for supercategory groupers,
- (==) this code only,
- (< Q) descendants only when in a qualifying Relationship,
- (< Q only) descendants only, and only allowed in a qualifying Relationship.

A supercategory grouper is sufficiently defined by reference to a value that is at the top of the value hierarchy, resulting in a very general meaning, such that the code is less useful (or sometimes useless) for record entry, but is useful as an organizer of the hierarchy.

### 6.2.2.2 Attribute Hierarchies in SNOMED CT

Selected SNOMED CT attributes have a hierarchical relationship to one another known as "attribute hierarchies". In an attribute hierarchy, one general attribute is the parent of one or more specific subtypes of that attribute. Concepts defined using the more general attribute can inherit concepts modelled with the more specific subtypes of that attribute.

#### 6.2.2.2.1 Attribute hierarchies used in modeling Procedures

Three groups of attributes are organised as a simple two-level hierarchy. The three top level attributes are | PROCEDURE SITE |, | PROCEDURE DEVICE |, and | PROCEDURE MORPHOLOGY |. Each has a sub-attribute to represent the direct object, and another to represent the indirect object. In addition, | PROCEDURE DEVICE | can be specialised by the attributes | USING DEVICE | and | USING ACCESS DEVICE |.

<table>
<thead>
<tr>
<th>PROCEDURE DEVICE</th>
<th>attribute hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>PROCEDURE DEVICE</td>
</tr>
<tr>
<td>•</td>
<td>DIRECT DEVICE</td>
</tr>
<tr>
<td>•</td>
<td>INDIRECT DEVICE</td>
</tr>
<tr>
<td>•</td>
<td>USING DEVICE</td>
</tr>
<tr>
<td>•</td>
<td>USING ACCESS DEVICE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROCEDURE MORPHOLOGY</th>
<th>attribute hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>PROCEDURE MORPHOLOGY</td>
</tr>
<tr>
<td>•</td>
<td>DIRECT MORPHOLOGY</td>
</tr>
<tr>
<td>•</td>
<td>INDIRECT MORPHOLOGY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROCEDURE SITE</th>
<th>attribute hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>PROCEDURE SITE</td>
</tr>
<tr>
<td>•</td>
<td>PROCEDURE SITE - DIRECT</td>
</tr>
<tr>
<td>•</td>
<td>PROCEDURE SITE - INDIRECT</td>
</tr>
</tbody>
</table>
6.2.2.2 Attribute hierarchy used in modeling Clinical Findings

- ASSOCIATED WITH

• | ASSOCIATED WITH |
  • | AFTER |
  • | DUE TO |
  • | CAUSATIVE AGENT |

6.2.2.3 Relationship groups in SNOMED CT

Multiple attributes and their values can be grouped together into "Relationship groups" to add clarity to concept definitions. A Relationship group combines an attribute-value pair with one or more other attribute-value pairs. Relationship groups originated to add clarity to Clinical finding concepts which require multiple ASSOCIATED MORPHOLOGY attributes and multiple FINDING SITE attributes and to Procedure which require multiple METHOD attributes and multiple PROCEDURE SITE attributes. However, Relationship groups are not limited to Clinical finding and Procedure concepts.

In the case of Procedure, Relationship groups generally associate the correct method with the correct site. In the example below, the Relationship groups clarify that there is exploration of the bile duct, and excision of the gall bladder. Without Relationship groups, the four attributes would be ungrouped and it would be unclear whether the excision was of the bile duct or of the gall bladder.

Figure 58: Example Cholecystectomy and exploration of bile duct

6.2.3 Hierarchies

SNOMED CT concepts are organised into hierarchies. There is one special concept referred to as the Root Concept Code. It represents the "root" of the hierarchy that contains all Concepts in SNOMED CT. The root named "SNOMED CT Concept" subsumes (is the supertype of) the top-level concepts (hierarchies parents) and all the concepts beneath them (their subtypes). As the hierarchies are descended,
the concepts within them become increasingly specific (or granular). A brief description of the content in each hierarchy is given below.

**Subtype** (or “child”) concepts are the descendant concepts of Supertype (or “parent”) concepts.

*Example:* | Streptococcal arthritis (disorder) | is a subtype of | Bacterial arthritis (disorder) |

**Supertype** concepts are the ancestor concepts of **Subtype** concepts.

*Example:* | Bacterial arthritis (disorder) | is a supertype of | Streptococcal arthritis (disorder) |

### 6.2.3.1 Summary of Top Level Hierarchies

#### 6.2.3.1.1 Top Level Concepts

| Physical force | | Event |
| Environment or geographical location | | Social context |
| Situation with explicit context | | Staging and scales |
| Physical object | | Qualifier value |
| Record artifact |

#### 6.2.3.1.2 Top Level Metadata

| Core metadata concept | | Foundation metadata concept |
| Linkage concept | | Namespace concept |

#### 6.2.3.2 Clinical finding

*Concepts* in this hierarchy represent the result of a clinical observation, assessment or judgement, and include both normal and abnormal clinical states.

**Examples of Clinical finding concepts:**

- | Clear sputum (finding) |
- | Normal breath sounds (finding) |
- | Poor posture (finding) |

The **Clinical finding** hierarchy contains the sub-hierarchy of **Disease**. *Concepts that are descendants of Disease* (or disorders) are always and necessarily abnormal clinical states. The **subtype polyhierarchy** allows diseases to be subclasses of other disorders as well as subtypes of findings.

**Examples of Disease concepts:**

- | Tuberculosis (disorder) |
- | non-Hodgkin's lymphoma (disorder) |

*Note:* See also *Attributes used to define Clinical Finding concepts.*
6.2.3.2.1 Clinical Finding - definition

Clinical findings have been defined as observations, judgements or assessments about patients. The problem with the terms finding and observation is that they seem to refer to the judgement of the observer rather than to the actual state of the body. Organism state has been suggested as a more neutral name, but it would need to be delimited from a course of disease. Examples of clinical findings include: difficulty swallowing, nose bleed, diabetes, headache, and so forth. More precise and reproducible definitions of clinical findings, and the precise boundaries between findings and events, between findings and observables, between findings and situations, and the distinction between finding and disorder, remain ongoing challenges at the margins. The distinction between a disorder and an observation has proven to be difficult to define in a reproducible manner across the tens of thousands of concepts included under clinical findings. Nevertheless, there are several reliable characteristics of each sub-category (disorders and findings):

6.2.3.2.1.1 Disorders

1. Disorders necessarily are abnormal.
2. They have temporal persistence, with the (at least theoretical) possibility of their manifestations being treated, in remission, or quiescent even though the disorder itself still present.
3. They necessarily have an underlying pathological process.

6.2.3.2.1.2 Findings

1. Findings may be normal (but not necessarily); no disorders may.
2. Some findings may exist only at a single point in time (e.g. a serum sodium level); no disorders may.
3. Findings cannot be temporally separate from the observing of them (you can't observe them and say they are absent, nor can you have the finding present when it is not capable of being observed).
4. They cannot be defined in terms of an underlying pathological process that is present even when the observation itself is not present.

Disorders may be present as a propensity for certain abnormal states to occur, even when treatment mitigates or resolves those abnormal states. In some cases the disease process is irrefutable, e.g. meningococcal meningitis. In others an underlying disease process is assumed based on the temporal and causal association of the disorder and its manifestation, e.g. nystagmus disorder is different from the finding/observation of nystagmus, which can be a normal physiological response to rotation of the head. If you spin around and around and then have nystagmus (the finding) you still do not have nystagmus disorder. And someone can have a nystagmus disorder without currently manifesting nystagmus. Similarly, deafness disorder is different from the symptom (observation) of reduced hearing, which can be due to a number of temporary causes such as excessive ear wax.

6.2.3.2.2 Attributes used to define Clinical Finding concepts

Table 108: Approved Clinical Finding attributes summary

<table>
<thead>
<tr>
<th>Defining Attribute</th>
<th>Subsumed Attribute</th>
<th>Allowable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINDING SITE</td>
<td>Anatomical or acquired body structure</td>
<td>442083009 (&lt;&lt;)</td>
</tr>
<tr>
<td>ASSOCIATED MORPHOLOGY</td>
<td>Morphologically abnormal structure</td>
<td>49755003 (&lt;&lt;)</td>
</tr>
<tr>
<td>Defining Attribute</td>
<td>Subsumed Attribute</td>
<td>Allowable Values</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>ASSOCIATED WITH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Procedure</td>
<td>71388002 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Event</td>
<td>272379006 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Organism</td>
<td>410607006 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Physical object</td>
<td>260787004 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Physical force</td>
<td>78621006 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Pharmaceutical / biologic product</td>
<td>373873005 (&lt;&lt; Q only)</td>
</tr>
<tr>
<td></td>
<td>SNOMED CT Concept</td>
<td>138875005 (==)</td>
</tr>
<tr>
<td></td>
<td>CAUSATIVE AGENT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Physical object</td>
<td>260787004 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Physical force</td>
<td>78621006 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Pharmaceutical / biologic product</td>
<td>373873005 (&lt;&lt; Q only)</td>
</tr>
<tr>
<td></td>
<td>SNOMED CT Concept</td>
<td>138875005 (==)</td>
</tr>
<tr>
<td></td>
<td>DUE TO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event</td>
<td>272379006 (&lt;=)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Procedure</td>
<td>71388002 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>SEVERITY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CLINICAL COURSE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EPISODICITY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTERPRETS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laboratory procedure</td>
<td>108252007 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Evaluation procedure</td>
<td>386053000 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>HAS INTERPRETATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PATHOLOGICAL PROCESS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infectious process</td>
<td>441862004 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Hypersensitivity process</td>
<td>472963003 (&lt; &lt;)</td>
</tr>
<tr>
<td></td>
<td>HAS DEFINITIONAL MANIFESTATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OCCURRENCE</td>
<td></td>
</tr>
<tr>
<td>Defining Attribute</td>
<td>Subsumed Attribute</td>
<td>Allowable Values</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>FINDING METHOD</td>
<td>Procedure</td>
<td>71388002 (&lt;=)</td>
</tr>
<tr>
<td>FINDING INFORMER</td>
<td>Performer of method</td>
<td>420158005 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Subject of record or other provider of history</td>
<td>419358007 (&lt;&lt;)</td>
</tr>
</tbody>
</table>

**Note:**
Meaning of Allowable Values (*Range*) notations:

- (<<) this code and descendants,
- (<) descendants only,
- (<=) descendants only (stated) except for supercategory groupers,
- (==) this code only,
- (< Q) descendants only when in a qualifying *Relationship*,
- (< Q only) descendants only, and only allowed in a qualifying *Relationship*.

**Note:** See also *Clinical finding*.

6.2.3.2.2.1 FINDING SITE

This attribute specifies the body site affected by a condition.

**Table 109: Permissible values for FINDING SITE**

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney disease (disorder)</td>
<td></td>
</tr>
<tr>
<td>FINDING SITE</td>
<td>Kidney structure (body structure)</td>
</tr>
<tr>
<td>Appendicitis (disorder)</td>
<td></td>
</tr>
<tr>
<td>FINDING SITE</td>
<td>Appendix structure (body structure)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.2 ASSOCIATED MORPHOLOGY

This attribute specifies the morphologic changes seen at the tissue or cellular level that are characteristic features of a disease.

**Table 110: Permissible values for ASSOCIATED MORPHOLOGY**

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone marrow hyperplasia (disorder)</td>
<td></td>
</tr>
<tr>
<td>ASSOCIATED MORPHOLOGY</td>
<td>Hyperplasia (morphologic abnormality)</td>
</tr>
<tr>
<td>Pancreatitis (disorder)</td>
<td></td>
</tr>
<tr>
<td>ASSOCIATED MORPHOLOGY</td>
<td>Inflammation (morphologic abnormality)</td>
</tr>
</tbody>
</table>
6.2.3.2.3 ASSOCIATED WITH

This attribute asserts an interaction between two concepts beyond simple co-occurrence in the patient. ASSOCIATED WITH represents a clinically relevant association between concepts without either asserting or excluding a causal or sequential relationship between the two.

Table 111: Permissible values for ASSOCIATED WITH

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Finding</td>
<td>404684003 (&lt;&lt;)</td>
</tr>
<tr>
<td>Procedure</td>
<td>71388002 (&lt;&lt;)</td>
</tr>
<tr>
<td>Event</td>
<td>272379006 (&lt;&lt;)</td>
</tr>
<tr>
<td>Organism</td>
<td>410607006 (&lt;&lt;)</td>
</tr>
<tr>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td>Physical object</td>
<td>260787004 (&lt;&lt;)</td>
</tr>
<tr>
<td>Physical force</td>
<td>78621006 (&lt;&lt;)</td>
</tr>
<tr>
<td>Pharmaceutical / biologic product</td>
<td>373873005 (&lt;&lt; Q only)</td>
</tr>
<tr>
<td>SNOMED CT Concept</td>
<td>138875005 (==)</td>
</tr>
</tbody>
</table>

| ASSOCIATED WITH | subsumes the following, more specific, attributes in what is called an attribute hierarchy (explained in Attribute Hierarchies in SNOMED CT on page 255):

- | AFTER |
- | DUE TO |
- | CAUSATIVE AGENT |

6.2.3.2.2.4 AFTER

This attribute is used to model concepts in which a clinical finding occurs after another clinical finding or procedure. Neither asserting nor excluding a causal relationship, it instead emphasises a sequence of events.

Table 112: Permissible values for AFTER

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Finding</td>
<td>404684003 (&lt;&lt;)</td>
</tr>
<tr>
<td>Procedure</td>
<td>71388002 (&lt;&lt;)</td>
</tr>
<tr>
<td>Post-viral disorder (disorder)</td>
<td></td>
</tr>
<tr>
<td>Viral disease (disorder)</td>
<td></td>
</tr>
</tbody>
</table>

This example can be paraphrased as: “every post-viral disorder occurs after some viral disease”.

6.2.3.2.2.5 DUE TO

This attribute is used to relate a Clinical finding directly to its cause. If a clinical finding merely predisposes to or worsens another disorder, rather than causing it directly, then the more general attribute ASSOCIATED WITH is used instead.
Table 113: Permissible values for DUE TO

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Finding</td>
<td>404684003 (&lt;=)</td>
</tr>
<tr>
<td>Event</td>
<td>272379006 (&lt;=)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.6 CAUSATIVE AGENT

This attribute identifies the direct causative agent of a disease. It does not include vectors, e.g. a mosquito that transmits malaria.

Table 114: Permissible values for CAUSATIVE AGENT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organism</td>
<td>410607006 (&lt;&lt;)</td>
</tr>
<tr>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td>Physical object</td>
<td>260787004 (&lt;&lt;)</td>
</tr>
<tr>
<td>Physical force</td>
<td>78621006 (&lt;&lt;)</td>
</tr>
<tr>
<td>Pharmaceutical / biologic product</td>
<td>373873005 (&lt;&lt; Q only)</td>
</tr>
<tr>
<td>SNOMED CT Concept</td>
<td>138875005 (==)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.7 SEVERITY

This attribute is used to subclass a Clinical finding concept according to its severity; however, caution is encouraged because this use is said to be relative. By relative, it is meant that it is incorrect to assume that the same degree of disease intensity or hazard is implied for all Clinical finding to which this attribute is applied. There are three reasons.

First, “severe” could be interpreted differently depending on what other values are available to choose for severity. Thus severity is relative to the other values in the value set presented to users. Consider the different meaning of severity in each of the following three sets of values:

- mild / moderate / severe
- minimal / mild / moderate / severe / very severe
- mild / mild to moderate / moderate / moderate to severe / severe / life threatening / fatal

Second, the severity is defined relative to the expected degree of intensity or hazard of the Clinical finding that is being qualified. A common cold has a baseline intensity or hazard much less than that of a more serious disease like lupus erythematosus or pneumonia; thus a severe cold might be considered less intense or hazardous than a mild pneumonia.

Third, some disorders that are life-threatening do not ordinarily have a severity assigned to them. Cancer, for example, is generally not subclassed according to mild, moderate and severe types, but rather is subclassed according to stage or grade.

For these reasons, the SEVERITY attribute cannot be relied on to retrieve all Clinical findings with serious or life-threatening import. Nevertheless, it is still useful for subclassing certain concepts and differentiating between different severities of a single disorder. SEVERITY is not used to model any concepts precoordinated in the International Release but it can still be used in postcoordination as a qualifier.
Table 115: Permissible values for SEVERITY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severities</td>
<td>272141005 (&lt;=)(&lt; Q)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.8 CLINICAL COURSE

This attribute is used to represent both the course and onset of a disease. Many conditions with an acute (sudden) onset also have an acute (short duration) course. Few diseases with a chronic (long-term) course would need to have their onset sub-divided into rapid or gradual subtypes, and thus there is no clear need for separating the rapidity of onset from the duration of a disease; based on testing by implementers and modelers, a single attribute with values that combine these meanings has clearly been more reproducible and useful than two attributes that attempt to separate the meanings.

Table 116: Permissible values for CLINICAL COURSE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses</td>
<td>288524001 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>Acute amebic dysentery (disorder)</td>
<td>CLINICAL COURSE</td>
</tr>
<tr>
<td>Chronic fibrosing pancreatitis (disorder)</td>
<td>CLINICAL COURSE</td>
</tr>
</tbody>
</table>

The word acute has more than one meaning, and the meanings are often overlapping or unclear. The word acute may imply rapid onset, short duration, or high severity; in some circumstances it might be used to mean all of these. For morphological terms it may also imply the kind of morphology associated with the speed of onset. | Acute inflammation (morphologic abnormality) | does not necessarily have CLINICAL COURSE | Sudden onset AND/OR short duration |, but rather implies polymorphonuclear infiltration; likewise | Chronic inflammation (morphologic abnormality) | implies mononuclear cell infiltration, not necessarily a chronic course, although inflammation with a chronic course is highly correlated with a lymphocytic infiltration.

6.2.3.2.2.9 EPISODICITY

| EPISODICITY | is used to represent episodes of care provided by a physician or other care provider, typically a general practitioner, not episodes of disease experienced by the patient. See EPISODICITY no longer modelled in active content on page 274, regarding the origin of the attribute. For example, asthma with | EPISODICITY |=| first episode | represents the first time the patient presents to their health care provider with asthma. EPISODICITY is not used to model any concepts precoordinated in the International Release but it can still be used in postcoordination as a qualifier.

Table 117: Permissible values for EPISODICITY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episodicities</td>
<td>288526004 (&lt;=)(&lt; Q)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.10 INTERPRETS

This attribute refers to the entity being evaluated or interpreted, when an evaluation, interpretation or “judgement” is intrinsic to the meaning of a concept. This attribute is usually grouped with the | HAS INTERPRETATION | attribute.
Table 118: Permissible values for INTERPRETS

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observable entity</td>
<td>363787002 (&lt;&lt;)</td>
</tr>
<tr>
<td>Laboratory procedure</td>
<td>108252007 (&lt;&lt;)</td>
</tr>
<tr>
<td>Evaluation procedure</td>
<td>386053000 (&lt;&lt;)</td>
</tr>
<tr>
<td>Abnormal glucose level (finding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** For concepts in the Measurement finding subhierarchy, the value for | INTERPRETS | should be an Evaluation procedure or a Laboratory procedure rather than an Observable entity.

6.2.3.2.2.11 HAS INTERPRETATION

This attribute is grouped with the attribute | INTERPRETS |, and designates the judgement aspect being evaluated or interpreted for a concept (e.g., presence, absence, degree, normality, abnormality, etc.).

Table 119: Permissible values for HAS INTERPRETATION

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Findings values</td>
<td>260245000 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>• INTERPRETS</td>
</tr>
<tr>
<td></td>
<td>• HAS INTERPRETATION</td>
</tr>
<tr>
<td>Abnormal glucose level (finding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.2.2.12 PATHOLOGICAL PROCESS

This attribute provides information about the underlying pathological process for a disorder, but only when the results of that process are not structural and cannot be represented by the | ASSOCIATED MORPHOLOGY | attribute.

The values | Infectious process (qualifier value) | and its subtype | Parasitic process (qualifier value) | are included in the range for | PATHOLOGICAL PROCESS |. These were added to accommodate the change in the modeling of concepts in the | Infectious disease (disorder) | subhierarchy where the infectious aspect of the disease is represented using | PATHOLOGICAL PROCESS |.
Table 120: Permissible values for PATHOLOGICAL PROCESS

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autoimmune (qualifier value)</td>
<td>Autoimmune parathyroiditis (disorder)</td>
</tr>
<tr>
<td>Infectious process (qualifier value)</td>
<td>Infectious process (qualifier value)</td>
</tr>
<tr>
<td>Hypersensitivity process (qualifier value)</td>
<td>Hypersensitivity process (qualifier value)</td>
</tr>
<tr>
<td>Autoimmune parathyroiditis (disorder)</td>
<td>Disease caused by parasite (disorder)</td>
</tr>
<tr>
<td>Infectious process (qualifier value)</td>
<td>Disease caused by parasite (disorder)</td>
</tr>
<tr>
<td>Hypersensitivity process (qualifier value)</td>
<td>Hypersensitivity process (qualifier value)</td>
</tr>
</tbody>
</table>

Pathological process must not be used for values that could overlap with ASSOCIATED MORPHOLOGY. Inflammatory processes result in inflammation (by definition), but these disorders should be defined using their morphology.

6.2.3.2.2.13 HAS DEFINITIONAL MANIFESTATION

This attribute links disorders to the manifestations (observations) that define them. It can only be applied to disorders.

Table 121: Permissible values for HAS DEFINITIONAL MANIFESTATION

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical finding (qualifier value)</td>
<td>Seizure disorder (disorder)</td>
</tr>
<tr>
<td>Hypertensive disorder, systemic arterial (qualifier value)</td>
<td>Hypertensive disorder, systemic arterial (disorder)</td>
</tr>
<tr>
<td>Seizure (finding)</td>
<td>Seizure (finding)</td>
</tr>
<tr>
<td>Finding of increased blood pressure (finding)</td>
<td>Finding of increased blood pressure (finding)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.14 OCCURRENCE

This attribute refers to the specific period of life during which a condition first presents. Multiple values of OCCURRENCE for a single concept are not desirable, and these will be addressed in a future release. This does not mean the condition cannot persist beyond the period of life in which it first presents.

Table 122: Permissible values for OCCURRENCE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periods of life (qualifier value)</td>
<td>Childhood phobic anxiety disorder (disorder)</td>
</tr>
<tr>
<td>Childhood (qualifier value)</td>
<td>Childhood phobic anxiety disorder (disorder)</td>
</tr>
</tbody>
</table>

6.2.3.2.2.15 FINDING METHOD

This attribute specifies the means by which a clinical finding was determined. This attribute is frequently used in conjunction with FINDING INFORMER. Findings that specify that they were determined by examination of the patient (e.g. On examination - ankle clonus (finding)) should have a value for both FINDING METHOD and FINDING INFORMER.
Table 123: Permissible values for FINDING METHOD

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure</td>
<td>71388002 (&lt;=)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.2.2.16 FINDING INFORMER

This attribute specifies the person or other entity from which the clinical finding information was obtained. This attribute is frequently used in conjunction with | FINDING METHOD |.

Table 124: Permissible values for FINDING INFORMER

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performer of method</td>
<td>420158005 (&lt;&lt;)</td>
</tr>
<tr>
<td>Subject of record or other provider of history</td>
<td>419358007 (&lt;&lt;)</td>
</tr>
<tr>
<td>On examination - ankle clonus (finding)</td>
<td>FINDING INFORMER</td>
</tr>
</tbody>
</table>

It is accepted that an information model should permit identification of a particular individual who provides information; | FINDING INFORMER | is not about the particular individual. It is about the category or type of informer, which is used to differentiate self-reported symptoms from provider-observed signs. Granted, this permits inclusion of epistemology-loaded terms (cf. Bodenreider et al., FOIS 2004), but health care is full of such terms, and they are (or at least can be) understandable, reproducible and useful.

6.2.3.2.3 Specific disorder types

6.2.3.2.3.1 Ischaemic disorders

Ischaemic disorders are defined by a morphology of ischaemic structural change. This need not be permanent structural change, but it is assumed that all ischaemia results in some structural alterations at the molecular level, at least, even if reversible.

6.2.3.2.3.1.1 Ischaemic heart disease

Ischaemic heart disease includes myocardial infarction, myocardial ischaemia (without infarction), angina, and other disorders of the heart that have ischaemic structural change (reversible or non-reversible) as a defining characteristic.

Coronary arteriosclerosis can of course be present without causing ischaemia, so | coronary arteriosclerosis | is not a subtype of | ischaemic heart disease |.

Likewise there are causes of myocardial ischaemia and infarction other than coronary arteriosclerosis, so | ischaemic heart disease | is not a subtype of | coronary arteriosclerosis |.

6.2.3.2.3.2 Cardiac Arrhythmia

Cardiologists noted that there had been confusion in the placement of | conduction disorder of the heart | as a broad grouper that subsumed arrhythmias and heart blocks, whereas the common understanding of "arrhythmia" is that this term refers to a broad set of conditions that include conduction disorders, under which are heart blocks. Consequently, a new concept | Cardiac arrhythmia (disorder) | was created as a parent of | Conduction disorder of the heart (disorder) |, and as the active referent of the inactive codes named "dysrhythmia" or "arrhythmia".

Conduction disorders include heart block, AV block, bundle branch block, conduction delay, and conduction defect. Other arrhythmias were moved out from under | Conduction disorder of the heart (disorder) | and placed under | Cardiac arrhythmia (disorder) |.
6.2.3.2.3.3 Lesion

The word lesion can be used to refer to both structural and functional abnormalities. If a disorder or procedure refers to a lesion in a way that makes it clear that it is a generic term for a structural abnormality, then the correct modelling approach is to use | Associated morphology | = morphologically abnormal structure (for disorders) or | Procedure morphology | (for procedures).

Functional-only lesions obviously should not be modelled using values from the | morphologically abnormal structure | hierarchy.

6.2.3.2.3.4 Trauma, injury, damage

The word “trauma” has multiple senses. The first distinction is physical damage to the body versus psychic trauma. We assume “trauma” means physical damage unless accompanied by words that make clear it is psychic.

Traumatic injury (disorder) is defined as any disorder with a morphology of “traumatic abnormality”. See known issues (below) for a discussion of the known problems with traumatic morphologies.

There is a problem that occurs if we attempt to require “injury” to be synonymous with “trauma” which can be best illustrated by the example of the very common usage of the word “injury” when referring to damage to the brain. An internet search for the phrase "non-traumatic brain injury" will show that this refers to brain damage that is the result of asphyxiation, stroke, drowning, toxic injury, etc., and not due to direct physical impact to the skull (the traumatic brain injuries). We needed a broad category that would allow us to categorise injuries broadly including non-traumatic ones. The concept created for this purpose is traumatic and/or non-traumatic injury (disorder).

6.2.3.2.3.4.1 Laceration, incised wound, rupture, traumatic rupture, spontaneous rupture:

The word “lacerated” has two meanings, which can be succinctly summarised as “torn” vs “cut”. Common clinical usage equates “laceration” with “incised wound”. For example, a common emergency room problem is accidental cuts of fingers with kitchen knives. These are routinely called “lacerations”. On the other hand, most dictionaries insist that “laceration” implies a wound with ragged edges as a result of tearing. Obstetrical lacerations carry this latter meaning. When structures are torn or ruptured, the edges are usually irregular.

There are two morphologies with a synonym of “laceration”: “incised wound”, and “traumatic rupture”. Modelers must choose which of these two meanings is intended when the word “laceration” or “lacerated” appears in a concept Description from the “injury” hierarchy.

More generally, ruptures can occur either as a result of injury or spontaneously. The word “rupture”, when applied to muscles and tendons, implies a traumatic injury (e.g. "rupture of collateral ligament of the knee"). But “rupture” when applied to an internal viscus may be either traumatic or spontaneous (e.g. rupture of aorta, rupture of ovary, etc).

“Rupture” has subtype morphologies “traumatic rupture” and “nontraumatic rupture”. It is important to make this distinction, at a minimum, in order to support queries related to the effects of trauma. Modelers should choose “traumatic rupture” as the value of Associated-morphology for concepts using the word “rupture” with anatomical sites (such as muscles and tendons) where rupture requires trauma, in the absence of a specific lesion. Modelers should choose “rupture” as the value of Associated-morphology for concepts using the word “rupture” with sites (such as internal organs) where both traumatic and spontaneous rupture are seen. Nontraumatic rupture is usually stated to be so, but may also be inferred if the thing rupturing is a lesion which ordinarily leads to spontaneous rupture in the absence of trauma (e.g. rupture of inflamed appendix).

6.2.3.2.3.4.2 Friction injury

An injury due to friction can be represented using a morphology of | Friction injury (morphologic abnormality) |, in which case it will not classify as a kind of wound. Examples of friction injuries that are not wounds would include "abrasion of tooth" and "mechanical irritation". However, most disorders that are named “abrasion” imply that skin or other body structure has been abraded away, and thus they should also be considered wounds. They will correctly classify as wounds after assigning the correct morphology for these skin abrasions, | Abrasion (morphologic abnormality) |.
6.2.3.2.3.5 Death

“Death” is an event, not a disorder. Concepts like “relatives died,” “death of companion” go under "life events - finding" which is under | social and personal history finding |.

6.2.3.2.3.5.1 Sudden Cardiac Death

"Sudden cardiac death" is a term used in clinical practise to refer to an arrhythmia that results in sudden loss of cardiac function which, if not quickly reversed, will lead to actual death (as opposed to a high risk of imminent death). This concept needs an FSN that indicates it is not a kind of death, and it should not be classified under “death” because individuals to whom this label is applied have not necessarily been officially declared dead, and are frequently revived. It is regarded as a subtype of "cardiac dysrhythmia."

6.2.3.2.3.6 Tumour vs. Neoplasm

The word "tumour" has two main meanings:

1. a mass, regardless of whether it is neoplastic or not, or
2. a neoplastic mass

Neoplasm is preferred since it is less ambiguous than tumour.

6.2.3.2.3.7 Primary vs secondary neoplastic disorders

SNOMED follows the usage in ICD-O, ICD-9 and ICD-10, where secondary malignant neoplasm of (site x) is uniformly interpreted to mean that metastasis has occurred to site x. The alternative reading (from site x) is not what is intended. If you want to code a metastasis from a lung tumour, then SNOMED also has codes that explicitly use the word from, such as 315006004 metastasis from malignant tumour of lung.

Detailed information about metastases (primary at site x, metastatic to site y) could possibly be recorded using one of two different styles: either a style using two expressions placed in two statements in the clinical record one statement for the primary and one statement for the secondary; or a style using only one expression. The two-expression style would be required to code the case with ICD9 or ICD10 codes, and it would be valid to use this style with SNOMED expressions also.

The one-statement style would have to use one SNOMED expression with two role groups each with a morphology and site that is appropriate to the level of detail required.

- 64572001 | disease |
- { 116676008 | ASSOCIATED MORPHOLOGY |=86049000 | neoplasm, malignant (primary) |
- 363698007 | FINDING SITE |=76752008 | breast structure |}
- { 116676008 | ASSOCIATED MORPHOLOGY |=14799000 | neoplasm, metastatic |
- 363698007 | FINDING SITE |=59441001 | lymph node structure |}

Figure 59: An example of the one-statement style: primary malignant neoplasm of breast metastatic to lymph node

The morphology code in the role group differentiates the primary from the secondary site.

This style of modelling, using a single statement/expression, does not cleanly permit one to differentiate between just a metastasis from the lung, versus both a primary lung tumour and a metastasis, at a particular instance point in time. The recommended solution to this problem is the two-statement style, with a third statement that links them, using the information model to accomplish the linkage, rather than trying to do it all in the terminology. This recommended style permits users to attach time-stamps and other instance identifiers to the primary neoplasm, and separate time-stamps and other instance identifiers to the metastasis. This appears more flexible and semantically robust.

On the other hand, if a user just wants a broad category expressing the site of the metastasis and the site of the primary, in the same statement, the one-expression style does allow that, as accommodated by some precoordinated codes that are modelled with two role groups as described above.

6.2.3.2.3.8 Neoplasm vs hamartoma

A neoplasm is defined as an abnormal growth of tissue no longer under normal control. A hamartoma is defined as a benign self-limited growth of disorganised mature cells normally found in the
region, representing faulty development. Since the cells in hamartomas are mature cells whose growth is under normal control, a hamartoma is not a neoplasm.

SNOMED attempts to sort out the disorder concepts that get confused in the area of tumours, neoplasms and hamartomas by making a neoplasm and/or hamartoma disorder category, with five subtypes:

1. hamartoma
2. neoplastic disease
3. haemangioma
4. lymphangioma
5. melanocytic nevus

Likewise in the morphologic abnormality hierarchy, we have neoplasm and/or hamartoma with five subtypes:

1. hamartoma
2. neoplasm
3. haemangioma - category
4. lymphatic vessel tumour
5. melanocytic nevus - category

Haemangiomas, lymphangiomas and melanocytic nevi can be either hamartomas (these are usually present at birth) or neoplasms (these usually develop later in life). All of the subtypes of haemangioma, lymphangioma or melanocytic nevus can thus be aggregated under these upper-level generalisations, immediately under neoplasm and/or hamartoma, without necessarily having to first attempt to (incorrectly) categorise them as either neoplasms or hamartomas.

Naevus

The word “naevus” has many different meanings. The differences generally hinge on answers to the following questions:

1. is it necessarily on the skin? Or can it be located in mucosal sites or other sites?
2. Is it necessarily visible? Or can it be in internal locations such as gastric mucosa, etc?
3. Is it necessarily present at birth? Or can it make its appearance later in life?
4. Is it necessarily dark and made of melanocytes? Or can it be non-pigmented, or made of other types of cells?
5. Is it necessarily made of tissue that is normally present at the site? Or can it be ectopic?
6. Does it exclude benign neoplasms?

Here are some common meanings of naevus based on some combinations of answers to these questions:

1. A birthmark, that is, any visible spot on the skin or oral mucosa present since birth, regardless of tissue of origin, excluding benign neoplasms.
2. Any benign cluster of melanocytes, regardless of location, and regardless of pigmentation, whether present since birth or appearing later.
3. Any cutaneous hamartoma. This excludes non-cutaneous sites, and excludes neoplasms and ectopic tissue such as choristomas.

As a result of this wide variation in meaning, any SNOMED FSN containing the word naevus is prone to being ambiguous. For example, consider “vascular naevus”. This term might mean:

1. congenital blood vessel tumours in the skin,
2. congenital blood vessel hamartomas or neoplasms that are visible somewhere (not just in the skin, but also including mucosa, whether visible externally or not),
3. congenital blood or lymphatic vessel tumours in the skin,
4. congenital blood or lymphatic vessel hamartomas or neoplasms that are visible somewhere,
any of the above but not necessarily congenital

A better FSN for vascular naevus (morphologic abnormality) would be vascular hamartoma (morphologic abnormality). Likewise a better FSN for congenital vascular naevus (disorder) would be congenital vascular hamartoma (disorder). In those cases where common clinical usage of a term containing nevus is unambiguous, there is no call for the term (or concept described using the term) to be retired.

6.2.3.2.3.10 Infectious disease vs. Inflammatory disorder

Infectious disease and inflammatory disorder are siblings. It might seem more intuitive for infectious disease to be a child of inflammatory disorder. However, not all infectious disorders are inflammatory. These concepts will remain siblings. Infectious disease and its subtypes have a CAUSATIVE AGENT Relationship to the organism that is infecting. Inflammatory disorder has an | ASSOCIATED MORPHOLOGY | Relationship to | inflammation (morphologic abnormality) | or one of its subtypes.

6.2.3.2.3.11 Post-infectious disorders

Post-infectious disorders are not subtypes of infectious disorders. The AFTER attribute is used for linking post-infectious disorders with their associated infections.

6.2.3.2.3.12 Congenital, hereditary, familial, developmental, genetic

6.2.3.2.3.12.1 Congenital

The attribute-value pair | occurrence |=| congenital | is applied to those disorders that are present at birth. Although the word congenital is often applied to genetic disorders, the term genetic is preferred for those disorders that arise from abnormalities of the genes.

The preferred modeling pattern for congenital disorders requires consideration of the possible use of | associated morphology | with values that are congenital morphologic abnormalities, and the | occurrence | attribute with a value of "congenital". The accepted pattern is to use | occurrence |=| congenital |, and to discontinue the use of congenital morphologic abnormality concepts as values of | associated morphology |, replacing them with their non-congenital morphologic supertype. Once the congenital morphologies are no longer in use, they will be retired.

| Occurrence | should be in the same role group as | associated morphology | and | finding site |, because the morphology is located at the site, and the occurrence applies to the combined morphology / site pair.

For general congenital anomaly disorder grouper concepts such as | Congenital anomaly of cardiovascular system (disorder) |, the preferred value for | associated morphology | is | Developmental anomaly (morphologic abnormality) |.

When modeling congenital disorders, the following guidelines should be followed:

1. Disorders with the word "congenital" in their FSN should be classified under | Congenital disease (disorder) |.
2. Do not make a direct stated assertion that the parent is | Congenital disease (disorder) |. Instead allow the classifier to infer this relationship.
3. All concepts to be classified under | Congenital disease (disorder) | should have a stated relationship | occurrence |=| congenital |
4. | Associated morphology | relationships will not be given values from under | Congenital anomaly (morphologic abnormality) |

6.2.3.2.3.12.2 Congenital vs. acquired

The general rule is that disorders in general may be either congenital or acquired, and congenital disorders are specifically modelled using OCCURRENCE = congenital, but there is no attribute for modelling the fact that a disorder is acquired. If the FSN does not mention either congenital or acquired, then we do not model the concept as being under congenital disorder, and there is nothing in the concept model to specifically indicate that it is necessarily acquired. There are a few concepts that have acquired in their FSN, but they remain primitive.

6.2.3.2.3.12.2.1 Congenital vs acquired syphilis

As an exception to the general rule that acquired is never assumed, syphilis is a disorder in which an FSN that does not mention congenital might be assumed to imply acquired. ICD seems to follow such a rule, but there is no rule to that effect in SNOMED. In the absence of such a rule, the precise
meaning of the FSN should be followed. If acquired is not stated in the FSN, the concept means the general category that subsumes both congenital and acquired forms.

6.2.3.2.3.12.3 Hereditary

It is difficult to cleanly define hereditary because it either may or may not include random mutations; the offspring of genetically normal parents may have a genetic disease, but there may be confusion about whether this is to be classified as a hereditary disease. It may be hereditary to the proband's offspring, but was not inherited from the proband's parents. Because of this ambiguity, hereditary requires case-by-case definition and is not a globally reproducible label for categories. Nevertheless, the names by which many diseases are known include the term, and is permitted as long as the usage does not introduce ambiguity.

6.2.3.2.3.12.4 Familial

The term familial is also somewhat ambiguous when used for broad categories. It may be interpreted as meaning that the disorder is found in higher proportions in the immediate or extended family than in other groups, or it may be intended as an indicator of possible heritable disease. In any case, it should not be used as a synonym for genetic.

6.2.3.2.3.12.5 Developmental

Developmental is a useful label for disorders that occur during development (both before and after birth) and that affect structures or functions that are in the process of developing. Some of these may be present at birth, and others may only manifest themselves post-natally.

6.2.3.2.3.12.6 Genetic, developmental, congenital and physical

The following diagram lays out the general logical structure of genetic, developmental and congenital categories, along with non-genetic, non-developmental and post-natal categories. A final dimension, called extrinsic physical force, is necessary to distinguish deformations from malformations. The various boxes in the diagram represent categories formed from the combination of the four dimensions each of which represents the answer to one of the following four questions:

1. is it genetic or not?
2. is it developmental or not?
3. is it present at birth or not?
4. is it due to an extrinsic physical force or not?

The diagonal hashed lines represent combination categories that do not occur. For example, there are no genetic disorders that are due to an extrinsic physical force. Likewise, there are no congenital disorders that are considered non-developmental. The blue lines represent congenital malformations; they may be either genetic or non-genetic in origin. The red circle represents those that are genetic in origin. Finally the solid coloured area represents the meaning of acquired, i.e. any disorder that is non-genetic and not present at birth.

Arrows leading from each of the non-hashed boxes in the central diagram point to examples of disorders that typify that category. For example, Huntington's disease is the typical example of a genetic disease that is neither congenital nor developmental. Although the gene defect is present at birth, the disease effects do not become manifest until adult life. Vitamin D deficiency rickets is a typical example of a non-genetic, non-congenital developmental malformation.
6.2.3.2.3.13 Malformation, deformation, anomaly

As illustrated in figure 1 and described in section 4.1, a deformation is a structural abnormality that is due to an extrinsic physical force. Malformations are those structural abnormalities that result from intrinsically disordered structural development. The word anomaly is, by itself, ambiguous because it may be used to mean any abnormality including non-structural ones, or it may be used to mean malformation, or it may be a general term that includes both malformation and deformation. Terms that contain the word anomaly must therefore be examined to see whether the additional words provide sufficient specificity to overcome the inherent ambiguity. Congenital anomaly of <x structure> is definitely structural but is not the same as congenital malformation, and therefore it can be regarded as having the more general meaning of structural abnormality present at birth.

Haematologic

There is more than one meaning of "haematologic". A structural definition based on "haematological system structure" would include haematopoietic and lymphoid structures (including bone marrow, spleen, thymus, lymph nodes, etc) as well as the cellular components of blood. Haematologic neoplasms clearly fit this definition.

A definition based on what haematologists do is broader. Disorders of haemostasis and thrombosis are managed by haematologists, but these do not have a common structural overlap with the lymphoid and haematopoietic systems (with the exception of platelets and megakaryocytes). For clarity, "haematologic disorder" is a navigational concept that could be used to define a reference set that would include disorders of blood and blood forming organs, as well as disorders of haemostasis and thrombosis, depending on what is intended.

If a patient says they have a haematologic disorder or a blood disorder, the navigational concept could be used to record and capture what they said, but the variability in meaning is too great to assign necessary and sufficient conditions to this phrase.
6.2.3.2.3.14.1 Haematologic disorders, lymphoid and myeloid neoplasms

When a clinician or patient (or the literature) says "haematologic disorder," they could be referring to disorders with a morphology of haematopoietic cell origin, disorders affecting the blood forming organs (bone marrow, lymph nodes, spleen, thymus, and other lymph tissues), disorders of the cellular components of blood, and/or disorders of the function of haemostatic and thrombotic systems.

Within SNOMED CT, diseases of the cellular components of blood are most readily defined in terms of their definitional manifestations (for example, anemia (disorder) | HAS DEFINITIONAL MANIFESTATION | Erythropenia (finding)), because there is no clearly defined body site (a cell type is not considered a body site) and there may be no defined morphology.

Diseases of the blood forming organs (bone marrow, lymph nodes, etc.) can be defined in terms of any one or a combination of the following:

1. The morphology. For neoplastic diseases this is understood, at a minimum, to include those morphologies covered by the neoplasms listed in ICD-O.
   Example:
   Hodgkin's disease (disorder) | ASSOCIATED MORPHOLOGY | Hodgkin lymphoma, no ICD-O subtype (morphologic abnormality)

2. The body site involved especially specific lymph node groups or skin sites.
   Example:
   primary cutaneous T-cell lymphoma (disorder) | FINDING SITE | skin structure

3. The definitional manifestations of the disease — for those diseases without a specific neoplastic morphology and/or without a specific topographical site of involvement other than the blood-forming organs in general.
   Example:
   toxic neutropenia (disorder) | HAS DEFINITIONAL MANIFESTATION | neutropenia (finding)

Important examples of where it is important to distinguish disorders defined by morphology versus site versus manifestation include the T-cell lymphomas and disorders of plasma cells/immunosecretory disorders. T-cell lymphomas can be subcategorised according to the site of the primary: a lymph node versus the skin or other extranodal site. This means that a site of "lymphoid structure" cannot therefore be the defining characteristic of the parent concept "T-cell lymphoma". Its defining attribute should be morphology alone. In the case of plasma cell disorders/immunosecretory disorders, some of them (monoclonal gammopathy, heavy chain disease, Waldenstrom's, etc) are defined in terms of their manifestation, i.e. the type of monoclonal protein they secrete, while others (myeloma, plasmacytoma) are defined in terms of their morphology, regardless of whether they are secretory or not. It would be incorrect to add "HAS DEFINITIONAL MANIFESTATION = monoclonal paraproteinemia" to myeloma, because not all myelomas are secretory. However, we can safely give immunosecretory disorders a morphology of "plasma cell neoplasm", even though no mass may have been identified and the monoclonal protein may be the only evidence that there is a clonal neoplasm.

In general, lymphoid and myeloid neoplasms can be modelled with their morphology alone, without a site. Leukemias and myelodysplastic syndromes are, in addition, modelled with site of bone marrow structure. Hairy cell leukemia has site bone marrow and site spleen, because both are uniformly involved.

6.2.3.2.3.14.2 Coagulation, Haemostasis and Thrombosis

There is more than one meaning of “coagulation”. A broad sense of “coagulation” as the stopping of bleeding is better described as haemostasis. A more narrow definition limited to the formation of the fibrin clot might exclude certain components of haemostasis, such as the ability to stop haemorrhage through the actions of blood vessels, collagen, endothelial cells, and platelets, in the absence of clotting.

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Individuals with congenital fibrinogen deficiency cannot form fibrin clots, yet they are able to stop bleeding. Therefore, coagulation disorders are kinds of haemostatic disorders.

6.2.3.2.3.15 Hernia, herniated structure, and hernial opening

Hernias involve two different structures, the structure herniated and the structure through which the hernia passes. Each of these might need to be described by different morphologies. There are two morphology codes, 414403008: | herniated structure (morphologic abnormality) |, and 414402003: | Hernial opening |. The herniated structure morphology should be the value of | ASSOCIATED MORPHOLOGY |, and this should be grouped with a | FINDING SITE | that has as its value the code for the anatomical structure that herniates.

Example:
Intestinal hernia (disorder)

- Group 1
  - | ASSOCIATED MORPHOLOGY | = herniated structure
  - | FINDING SITE | = intestinal structure

- Group 2
  - | ASSOCIATED MORPHOLOGY | = hernial opening
  - | FINDING SITE | = abdominal structure

The hernial opening morphology should be grouped with a | Finding site | attribute, with a value which is the code for the anatomical structure through which the hernia passes. It can be a general concept such as abdominal structure if the concept is non-specific about what is being herniated through. One or the other of these role groups should be omitted if the hernia does not necessarily entail a particular herniated structure or a particular hernial opening. For example, abdominal wall hernia specifies the hernial opening but not the herniated structure. In this case, the definition should omit the group with a morphology of herniated structure.

6.2.3.2.3.16 Osteoarthritis

Osteoarthritis is classically regarded as a degenerative disease, despite the "-itis" in its name. Because of this, | osteoarthritis | is not a subtype of | arthritis | in the disorder hierarchy. All cases of arthritis must be inflammatory by definition, but osteoarthritis has a subclass in the medical literature called non-inflammatory osteoarthritis. In fact, according to many authoritative sources, osteoarthritis is usually regarded as a non-inflammatory disease, and therefore it is not strictly a subtype of arthritis.

Structuring the hierarchy this way does not imply that there are no cases of osteoarthritis with inflammation, nor does it rule out inflammation as an etiologic or contributory factor in many cases. It is well established that inflammation occurs in many cases of osteoarthritis, and treatment with anti-inflammatory agents has been shown to be more effective than pure analgesics in many cases. The key point is that despite growing evidence of a role of inflammatory cytokines in many cases, osteoarthritis is not always necessarily an inflammatory disorder of the joint.

6.2.3.2.4 Changes and historical notes

6.2.3.2.4.1 EPISODICITY no longer modelled in active content

| EPISODICITY | originated in the National Health Service Clinical Terms Version 3 where it was used not to specify the first episode of a disease for a patient but rather, the first time a patient presented to their general practitioner (GP) for a particular disorder. A first episode of asthma was not intended to represent the first time a patient had asthma, but rather the first time a patient presented to their GP with asthma. | EPISODICITY | has been removed from existing concepts and is no longer used in precoordinated definitions. It can still be used in postcoordination as a qualifier.

6.2.3.2.4.2 ONSET and COURSE retired

In earlier releases, there were two attributes named | ONSET | and | COURSE |. These were retired because they could not be used reproducibly. While | ONSET | was intended to specify the rapidity of onset or the temporal pattern of presentation for a given condition, it was easily confused with the attribute | COURSE | used to represent the duration of a condition. There was not consistent agreement between observers making this distinction.
6.2.3.2.4.3 Dose form values moved

The concept 105904009 | Type of drug preparation (product) | and its subtypes were moved to the Qualifier value hierarchy as of the July 2007 release. 105904009 | Type of drug preparation (qualifier value) | better represents these concepts because they are not products.

6.2.3.2.4.4 Renaming the context/situation hierarchy

The hierarchy named 243796009 | situation with explicit context (situation) | was called context-dependent category until the July 2006 release. The hierarchy was renamed to better describe the meanings in this hierarchy.

6.2.3.2.4.5 Domain change for measurement/evaluation attributes

In releases prior to July 2009, six attributes were approved for use for measurement procedure only. For the July 2009 release, the domain for these attributes was expanded to evaluation procedure. See Measurement procedures and laboratory procedures on page 291 for a definition and full discussion of evaluation procedure and measurement procedure.

6.2.3.2.4.6 Move of findings to events

In January 2006, a number of concepts from the Clinical finding hierarchy were moved to the Event hierarchy. The attributes used to define those concepts when they were descendants of Clinical finding were retained after the concepts were moved to the Event hierarchy. Additional editorial policies for the use of attributes in the Event hierarchy have yet to be established.

6.2.3.3 Procedures

The top level of the procedure hierarchy has the following structure:

SNOMED CT concept

- procedure
  - administrative procedure
  - community health procedure
  - environmental care procedure
  - general treatment
  - laboratory procedure
  - obstetric procedure
  - outpatient procedure
  - patient encounter procedure
  - preoperative/postoperative procedures
  - procedure by device
  - procedure by intent
  - procedure by method
  - procedure by priority
  - procedure by site
  - procedure in coronary care unit
  - procedure related to anaesthesia and sedation
  - procedure with a clinical finding focus
  - procedure with a procedure focus
  - provider-specific procedure
  - regimes and therapies
  - social service procedure
  - specimen collection
  - staff related procedure

6.2.3.3.1 Procedure

| Procedure | concepts represent activities performed in the provision of health care. This hierarchy represents a broad variety of activities, including but not limited to, invasive procedures (e.g. Excision of intracranial artery (procedure)), administration of medicines (e.g. Pertussis vaccination |
Examples of Procedure concepts:

- Removal of urethral catheter (procedure)
- Intravenous steroid injection (procedure)
- Irrigation of oral wound (procedure)
- Appendectomy (procedure)

Note: See also Attributes used to define Procedure concepts.

6.2.3.3.2 Attributes used to define Procedure concepts

Table 125: Approved Procedure attributes summary

<table>
<thead>
<tr>
<th>Defining Attribute</th>
<th>Subsumed Attribute</th>
<th>Allowable Values</th>
</tr>
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<tbody>
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<td>PROCEDURE SITE</td>
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<tr>
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<td>PROCEDURE DEVICE</td>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td>DIRECT DEVICE</td>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td>INDIRECT DEVICE</td>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td>USING DEVICE</td>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td>USING ACCESS DEVICE</td>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td>ACCESS</td>
<td>Surgical access values</td>
<td>309795001 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>DIRECT SUBSTANCE</td>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Pharmaceutical / biologic product</td>
<td>373873005 (&lt;&lt;)</td>
</tr>
<tr>
<td>Defining Attribute</td>
<td>Subsumed Attribute</td>
<td>Allowable Values</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>PRIORITY</td>
<td>Priorities</td>
<td>272125009 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>HAS FOCUS</td>
<td>Clinical finding</td>
<td>404684003 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Procedure</td>
<td>71388002 (&lt;&lt;)</td>
</tr>
<tr>
<td>HAS INTENT</td>
<td>Intents (nature of procedure values)</td>
<td>363675004 (&lt;=)</td>
</tr>
<tr>
<td>RECIPIENT CATEGORY</td>
<td>Person</td>
<td>125676002 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Family</td>
<td>35359004 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Community</td>
<td>133928008 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Donor for medical or surgical procedure</td>
<td>105455006 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>389109008 (&lt;&lt;)</td>
</tr>
<tr>
<td>REVISION STATUS</td>
<td>Primary operation</td>
<td>261424001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Revision - value</td>
<td>255231005 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Part of multistage procedure</td>
<td>257958009 (&lt;&lt;)</td>
</tr>
<tr>
<td>ROUTE OF ADMINISTRATION</td>
<td>Route of administration value</td>
<td>284009009 (&lt;&lt;)</td>
</tr>
<tr>
<td>SURGICAL APPROACH</td>
<td>Procedural approach</td>
<td>103379005 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>USING ENERGY</td>
<td>Physical force</td>
<td>78621006 (&lt;&lt;)</td>
</tr>
<tr>
<td>USING SUBSTANCE</td>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
</tbody>
</table>

**Note:**
Meaning of Allowable Values (Range) notations:

- (<<) this code and descendants,
- (<) descendants only,
- (<=) descendants only (stated) except for supercategory groupers,
- (==) this code only,
- (< Q) descendants only when in a qualifying Relationship,
- (< Q only) descendants only, and only allowed in a qualifying Relationship.

**Note:**
Attributes should be grouped with the | METHOD | attribute to which they apply; in the absence of a | METHOD | attribute, attributes that are related to each other should be grouped. The one exception is | RECIPIENT CATEGORY |, because a single procedure code should not be precordinated in situations where more than one recipient category is involved. Such complex statements should utilise two or more procedure codes that are placed into an appropriately structured information model.

**Note:** See also Procedure.
6.2.3.3.2.1 PROCEDURE SITE

The PROCEDURE SITE attribute describes the body site acted on or affected by a procedure. This attribute subsumes, in an attribute hierarchy (see Attribute Hierarchies in SNOMED CT on page 255), the more specific attributes ( | Procedure site - Direct | and | Procedure site - Indirect |) that should be used if possible. The anatomical site may be directly acted on ( | Procedure site - Direct |) or indirectly acted upon ( | Procedure site - Indirect |).

When modeling procedures where the METHOD is Removal - action | or one of its subtypes (e.g. Excision |, Surgical biopsy |, etc.), removals of the structure itself should use | Procedure site - Direct |. Removals of tissue lesions (cysts, tumours, etc.) are considered to be removals of the site, and should also use | Procedure site - Direct |. Removals of devices, calculi, thrombi, foreign bodies and other non-tissue entities from the structure should use | Procedure site - Indirect |.

| Table 126: Permissible values for PROCEDURE SITE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomical or acquired body structure</td>
<td>Procedure on colon (procedure)</td>
</tr>
<tr>
<td>442083009 &lt;&lt;</td>
<td>PROCEDURE SITE</td>
</tr>
</tbody>
</table>

Procedures need not necessarily be categorised by site. Human body structure should not be assigned as a default value of this attribute because many procedures can be performed on non-human subjects, and because this attribute does not necessarily need to be present in a procedure concept definition in order for classifier algorithms to work properly.

The general PROCEDURE SITE attribute is used to model the site for high-level grouper type procedure concepts. It is most likely to be used for concepts that do not require a METHOD (action) attribute. Relatively few concepts will be modelled using | Procedure site |, rather than the more specific direct and indirect site attributes (see below).

6.2.3.3.2.1.1 PROCEDURE SITE DIRECT

This attribute is used when the action of the procedure is directly aimed at an anatomical or acquired body structure or site rather than at something else (such as a device) located there.

| Table 127: Permissible values for PROCEDURE SITE DIRECT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomical or acquired body structure</td>
<td>Amputation of the foot (procedure)</td>
</tr>
<tr>
<td>442083009 &lt;&lt;</td>
<td>METHOD</td>
</tr>
<tr>
<td></td>
<td>Procedure site - Direct</td>
</tr>
</tbody>
</table>

| Biopsy of femur (procedure) |
| METHOD | Biopsy - action (qualifier value) |
| Procedure site - Direct | Bone structure of femur (body structure) |

6.2.3.3.2.1.1.1 Multiple values for PROCEDURE SITE DIRECT

When the METHOD (action) acts directly on a morphological abnormality (more simply, a lesion) arising from, or existing in, the cells of the tissue in which it occurs [e.g. a tumour (including metastatic tumours), granuloma, polyp, or cyst] the attribute DIRECT MORPHOLOGY is used to model the morphological abnormality. Most concept definitions where DIRECT MORPHOLOGY is used, which also require a site in the definition, will use | Procedure site - Direct |. Thus, there can be more than one direct object of the METHOD for a concept. For example, the DIRECT MORPHOLOGY and the |
Procedure site - Direct | can both be direct objects of the | METHOD |. An example of an exception to this rule would be removal of a calculus from the ureter. In this case, the calculus is the direct object, but there is no procedure site that is that direct object, since the ureter is an indirect object.

The most common concepts that have more than one direct object of the | METHOD | are Subtypes of | Removal (procedure) | where the object of the removal (e.g. a neoplasm) can be considered to be a part of the tissue at the anatomical site in which it occurs. When a part of an anatomical structure (however abnormal) has been removed, both the morphological abnormality and the anatomical structure in which it is located are to be modelled as direct objects for the | METHOD | | Removal - action (qualifier value) |. Grafts that become attached via in-growth of capillaries, fibroblasts, and/or other cells or tissues would also be regarded as biologically connected, and therefore modeling their removal would include the anatomical structure as a direct object of the action. The anatomical structure is not to be modelled as a direct object of a removal only when the procedure does not necessarily involve removal also of part of the anatomy; examples include removals of things such as a foreign body, a catheter, a renal calculus, or a mechanical implant like a pacemaker.

6.2.3.3.2.1.2 PROCEDURE SITE INDIRECT

This attribute describes the anatomical site, which is acted upon, but is not the direct object of the procedure. (The site is indirectly acted on by the procedure.) Usually in these procedures there is another value that is the direct object of the action. Exceptions (concepts that do not specify a direct object, but only an indirect object) are usually general groupers such as | Arm implantation (procedure) | (meaning implantation of something into the arm), since the thing implanted could be either a device or a substance (material).

Table 128: Permissible values for PROCEDURE SITE INDIRECT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomical or acquired body structure</td>
<td>442083009 (&lt;&lt;)</td>
</tr>
<tr>
<td>•</td>
<td>METHOD</td>
</tr>
<tr>
<td>•</td>
<td>DIRECT DEVICE</td>
</tr>
<tr>
<td>•</td>
<td>Procedure site - Indirect</td>
</tr>
<tr>
<td>•</td>
<td>METHOD</td>
</tr>
<tr>
<td>•</td>
<td>DIRECT MORPHOLOGY</td>
</tr>
<tr>
<td>•</td>
<td>Procedure site - Indirect</td>
</tr>
</tbody>
</table>

6.2.3.3.2.2 PROCEDURE MORPHOLOGY

| PROCEDURE MORPHOLOGY | is the attribute used to specify the morphology or abnormal structure involved in a procedure. This attribute subsumes the more specific attributes | DIRECT MORPHOLOGY | and | INDIRECT MORPHOLOGY | that should be used if possible (see below). | DIRECT MORPHOLOGY | is used when the procedure method acts directly on the morphologic abnormality. | INDIRECT MORPHOLOGY | is used when the procedure method acts directly on something else (e.g. a device, substance or anatomical structure) that is associated with the morphologic abnormality. The more general attribute | PROCEDURE MORPHOLOGY | is used when defining general concepts that subsume both kinds of sub-concepts.
Table 129: Permissible values for PROCEDURE MORPHOLOGY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphologically abnormal structure</td>
<td>49755003 (&lt;&lt;)</td>
</tr>
</tbody>
</table>

Haematoma, calculus, foreign body, blood clot, embolus, and some other entities are not strictly body structures, but are in the body structure hierarchy under morphologically abnormal structure, and are valid values for the PROCEDURE MORPHOLOGY attributes.

6.2.3.3.2.2.1 DIRECT MORPHOLOGY

This attribute describes the morphologically abnormal structure that is the direct object of the METHOD action.

Table 130: Permissible values for DIRECT MORPHOLOGY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphologically abnormal structure</td>
<td>49755003 (&lt;&lt;)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Excision of benign neoplasm (procedure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• METHOD</td>
</tr>
<tr>
<td>• DIRECT MORPHOLOGY</td>
</tr>
</tbody>
</table>

6.2.3.3.2.2.2 INDIRECT MORPHOLOGY

This attribute represents a morphology that is acted upon, but is not the direct target of the action being performed (i.e. the procedure’s method acts directly on something else, such as a device, substance, or anatomical structure).

Table 131: Permissible values for INDIRECT MORPHOLOGY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphologically abnormal structure</td>
<td>49755003 (&lt;&lt;)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Removal of mesh from wound (procedure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• METHOD</td>
</tr>
<tr>
<td>• DIRECT DEVICE</td>
</tr>
<tr>
<td>• INDIRECT MORPHOLOGY</td>
</tr>
</tbody>
</table>

6.2.3.3.2.3 METHOD

This attribute represents the action being performed to accomplish the procedure. It does not include the surgical approach (e.g. translumbar), equipment (e.g. sutures), or physical forces (e.g. laser energy).

Table 132: Permissible values for METHOD

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action</td>
<td>129264002 (&lt;&lt;)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incision of ureter (procedure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• METHOD</td>
</tr>
<tr>
<td>• Procedure site - Direct</td>
</tr>
</tbody>
</table>
The `METHOD` can be considered the anchor of each `relationship group` that defines a procedure; if there are two methods, there should be two different `relationship groups`. It is correct to regard each `relationship group` as a kind of sub-procedure that defines the overall procedure. Each method can be regarded as the verb of a sentence, and the verbs direct and indirect objects are specified by the site, morphology, device, substance or energy attributes (below) that are grouped with it.

### 6.2.3.3.2.4 PROCEDURE DEVICE

| PROCEDURE DEVICE | is a general attribute used to model devices associated with a procedure. It subsumes the more specific attributes | DIRECT DEVICE |, | INDIRECT DEVICE |, | USING DEVICE |, and | USING ACCESS DEVICE |, which should be used instead of | PROCEDURE DEVICE | if possible. The general attribute | PROCEDURE DEVICE | is mainly useful for defining high-level, general concepts that aggregate procedures according to the device involved.

#### Table 133: Permissible values for PROCEDURE DEVICE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When the device is the direct object of the action ( | METHOD |), the attribute | DIRECT DEVICE | is used. If the action is done indirectly to the device, that is, the action is done to something that is located in or on a device, but is not done directly to the device itself, then the attribute | INDIRECT DEVICE | is used. If the device is used to carry out the action, then the attribute | USING DEVICE | is used. If the device is used to access the site of the action, then the attribute | USING ACCESS DEVICE | is used.

**Note:** The permissible values for attributes in the | PROCEDURE DEVICE | role hierarchy include | Device (physical object) | and its descendants. However, there are a limited number of products in SNOMED CT which are devices that also deliver drugs. These concepts descend from | Drug-device combination product (product) | which is a descendant of both | Device (physical object) | and | Pharmaceutical / biologic product (product) |. Therefore, although they carry the hierarchy tag of (product), they are valid values for attributes in the | PROCEDURE DEVICE | role hierarchy.

**Example:**

| Removal of drug coated stent (procedure) | |
| | METHOD | Removal - action (qualifier value) | |
| | DIRECT DEVICE | Drug coated stent (product) |

#### 6.2.3.3.2.4.1 DIRECT DEVICE

This attribute represents the device on which the method directly acts.

#### Table 134: Permissible values for DIRECT DEVICE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 6.2.3.3.2.4.2 INDIRECT DEVICE

This attribute models action done on something that is located in or on a device, but is not done directly on the device itself.
Table 135: Permissible values for INDIRECT DEVICE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
In the above example, the vegetation is being excised. The mitral valve prosthesis is where the excised vegetation is located but the mitral valve prosthesis itself is not excised. Thus, mitral valve prosthesis is the INDIRECT DEVICE.

Note:
The attribute INDIRECT DEVICE is infrequently needed. When using this attribute, a second look is advisable to be sure it is needed.

6.2.3.3.2.4.3 USING DEVICE

This attribute refers to the instrument or equipment utilised to execute an action. USING DEVICE is used when the device is actually used to carry out the action that is the focus of the procedure. If the device is simply the means to access the site of the procedure, then USING ACCESS DEVICE is used instead of USING DEVICE.

Table 136: Permissible values for USING DEVICE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.3.2.4.4 USING ACCESS DEVICE

This attribute specifies the instrument or equipment used to access the site of a procedure.

Table 137: Permissible values for USING ACCESS DEVICE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>49062001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.2.3.3.2.5 ACCESS
This attribute describes the route used to access the site of a procedure. It is used to distinguish open, closed, and percutaneous procedures.

Table 138: Permissible values for ACCESS

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical access values</td>
<td>309795001 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.3.2.6 DIRECT SUBSTANCE
This attribute describes the Substance or Pharmaceutical / biologic product on which the procedure's method directly acts.

Table 139: Permissible values for DIRECT SUBSTANCE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td>Pharmaceutical / biologic product</td>
<td>373873005 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: As an editorial policy, in the distribution form of the International Release, Pharmaceutical / biologic product (product) and its descendants are not used as values for DIRECT SUBSTANCE.

6.2.3.3.2.7 PRIORITY
This attribute refers to the priority assigned to a procedure.

Table 140: Permissible values for PRIORITY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priorities</td>
<td>272125009 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.3.2.8 HAS FOCUS
This attribute specifies the Clinical finding or Procedure which is the focus of a procedure.

Table 141: Permissible values for HAS FOCUS

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical finding</td>
<td>404684003 (&lt;&lt;)</td>
</tr>
<tr>
<td>Procedure</td>
<td>71388002 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.3.2.9 HAS INTENT
This attribute specifies the intent of a procedure.
Table 142: Permissible values for HAS INTENT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intents (nature of procedure values)</td>
</tr>
<tr>
<td>Diagnostic bronchoscopy (procedure)</td>
<td></td>
</tr>
<tr>
<td>HAS INTENT</td>
<td>Diagnostic intent (qualifier value)</td>
</tr>
</tbody>
</table>

6.2.3.3.2.10 RECIPIENT CATEGORY

This attribute specifies the type of individual or group upon which the action of the procedure is performed. For example, it can be used in blood banking procedures to differentiate whether the procedure was performed on the donor or the recipient of a blood product. In other words, | RECIPIENT CATEGORY | is | Donor for medical or surgical procedure (person) | if the subject of the record is the donor.

It is not used for a procedure where the subject of the procedure is someone other than the subject of record.

Table 143: Permissible values for RECIPIENT CATEGORY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>125676002 (&lt;&lt;)</td>
</tr>
<tr>
<td>Family</td>
<td>35359004 (&lt;&lt;)</td>
</tr>
<tr>
<td>Community</td>
<td>133928008 (&lt;&lt;)</td>
</tr>
<tr>
<td>Donor for medical or surgical procedure</td>
<td>105455006 (&lt;&lt;)</td>
</tr>
<tr>
<td>Group</td>
<td>389109008 (&lt;&lt;)</td>
</tr>
<tr>
<td>Social service interview of family (procedure)</td>
<td></td>
</tr>
<tr>
<td>RECIPIENT CATEGORY</td>
<td>Family (social concept)</td>
</tr>
</tbody>
</table>

6.2.3.3.2.11 REVISION STATUS

This attribute specifies whether a procedure is primary or a revision.

Table 144: Permissible values for REVISION STATUS

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary operation</td>
<td>261424001 (&lt;&lt;)</td>
</tr>
<tr>
<td>Revision - value</td>
<td>255231005 (&lt;&lt;)</td>
</tr>
<tr>
<td>Part of multistage procedure</td>
<td>257958009 (&lt;&lt;)</td>
</tr>
<tr>
<td>Primary repair of inguinal hernia (procedure)</td>
<td></td>
</tr>
<tr>
<td>REVISION STATUS</td>
<td>Primary operation (qualifier value)</td>
</tr>
<tr>
<td>Revision of knee arthroplasty (procedure)</td>
<td></td>
</tr>
<tr>
<td>REVISION STATUS</td>
<td>Revision - value (qualifier value)</td>
</tr>
</tbody>
</table>

6.2.3.3.2.12 ROUTE OF ADMINISTRATION

This attribute allows representation of the route by which a procedure introduces a given substance into the body.

The domain for this attribute is the sub-hierarchy below | Administration of substance via specific route (procedure) | 433590000.
Table 145: Permissible values for ROUTE OF ADMINISTRATION

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route of administration value</td>
<td>284009009 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Intravitreal steroid injection (procedure)</td>
</tr>
<tr>
<td></td>
<td>ROUTE OF ADMINISTRATION</td>
</tr>
<tr>
<td></td>
<td>Intravitreal route (qualifier value)</td>
</tr>
</tbody>
</table>

6.2.3.3.2.13 SURGICAL APPROACH

This attribute specifies the directional, relational, or spatial access to the site of a surgical procedure. The domain for SURGICAL APPROACH is descendants of Surgical procedure (procedure) | 387713003.

Table 146: Permissible values for SURGICAL APPROACH

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural approach</td>
<td>103379005 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td></td>
<td>Intranasal ethmoidectomy (procedure)</td>
</tr>
<tr>
<td></td>
<td>SURGICAL APPROACH</td>
</tr>
<tr>
<td></td>
<td>Intranasal approach (qualifier value)</td>
</tr>
<tr>
<td></td>
<td>Abdominal hysterectomy (procedure)</td>
</tr>
<tr>
<td></td>
<td>SURGICAL APPROACH</td>
</tr>
<tr>
<td></td>
<td>Abdominal approach (qualifier value)</td>
</tr>
</tbody>
</table>

6.2.3.3.2.14 USING SUBSTANCE

This attribute describes the Substance used to execute the action of a procedure, but it is not the substance on which the procedure's method directly acts (the DIRECT SUBSTANCE).

Table 147: Permissible values for USING SUBSTANCE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Contrast radiography of esophagus (procedure)</td>
</tr>
<tr>
<td></td>
<td>METHOD</td>
</tr>
<tr>
<td></td>
<td>Radiographic imaging - action (qualifier value)</td>
</tr>
<tr>
<td></td>
<td>Procedure site - Direct</td>
</tr>
<tr>
<td></td>
<td>Esophageal structure (body structure)</td>
</tr>
<tr>
<td></td>
<td>USING SUBSTANCE</td>
</tr>
<tr>
<td></td>
<td>Contrast media (substance)</td>
</tr>
</tbody>
</table>

6.2.3.3.2.15 USING ENERGY

This attribute describes the energy used to execute an action. USING ENERGY has been introduced because the new attribute USING DEVICE is now used only to represent the instrument or equipment used to execute the action. Unlike the attribute USING, which it replaces, USING DEVICE does not take values from the physical force hierarchy.

Table 148: Permissible values for USING ENERGY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical force</td>
<td>78621006 (&lt;&lt;)</td>
</tr>
<tr>
<td></td>
<td>Gamma ray therapy (procedure)</td>
</tr>
<tr>
<td></td>
<td>USING ENERGY</td>
</tr>
<tr>
<td></td>
<td>Gamma radiation (physical force)</td>
</tr>
</tbody>
</table>
6.2.3.3.2.16 Direct and indirect objects

Procedures that have a | METHOD | attribute can be described using an action verb that corresponds to the method. The direct object(s) of the action verb should be represented using (at least) one of the four direct object attributes, depending on whether the direct object on which the method acts is a device (| DIRECT DEVICE |), anatomical structure (| Procedure site - Direct |), morphologic abnormality (| DIRECT MORPHOLOGY |) or substance (| DIRECT SUBSTANCE |).

When the type (body structure, device, or substance) of direct object is indeterminate, the direct-object attributes should not be used.

6.2.3.3.3 Attributes used to define Evaluation Procedure concepts

Table 149: Approved Evaluation Procedure attributes summary

<table>
<thead>
<tr>
<th>Defining Attribute</th>
<th>Allowable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HAS SPECIMEN</td>
</tr>
<tr>
<td></td>
<td>COMPONENT</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TIME ASPECT</td>
</tr>
<tr>
<td></td>
<td>PROPERTY</td>
</tr>
<tr>
<td></td>
<td>SCALE TYPE</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEASUREMENT METHOD</td>
</tr>
</tbody>
</table>

Note:

Meaning of Allowable Values (Range) notations:

(<=) this code and descendants,
(<) descendants only,
(<=) descendants only (stated) except for supercategory groupers,
(==) this code only,
(< Q) descendants only when in a qualifying Relationship,
(< Q only) descendants only, and only allowed in a qualifying Relationship.

Note: See also Observable entity.
6.2.3.3.3.1 HAS SPECIMEN
This attribute specifies the type of specimen on which a measurement or observation is performed.

Table 150: Permissible values for HAS SPECIMEN

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen</td>
<td>123038009 (&lt;=)(&lt; Q)</td>
</tr>
</tbody>
</table>

6.2.3.3.3.2 COMPONENT
This attribute refers to what is being observed or measured by a procedure.

Table 151: Permissible values for COMPONENT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>Observable entity</td>
<td>363787002 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>Cell structure</td>
<td>4421005 (&lt;=)(&lt; Q)</td>
</tr>
<tr>
<td>Organism</td>
<td>410607006 (&lt;=)(&lt; Q)</td>
</tr>
</tbody>
</table>

| Protein measurement (procedure) | |
| COMPONENT | Protein (substance) |

6.2.3.3.3.3 TIME ASPECT
This attribute specifies temporal relationships for a measurement procedure.

Table 152: Permissible values for TIME ASPECT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time frame</td>
<td>7389001 (&lt;=)(&lt; Q)</td>
</tr>
</tbody>
</table>

6.2.3.3.3.4 PROPERTY
This attribute specifies the kind of property being measured (e.g. concentration).

Table 153: Permissible values for PROPERTY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property of measurement</td>
<td>118598001 (&lt;=)(&lt; Q)</td>
</tr>
</tbody>
</table>

6.2.3.3.3.5 SCALE TYPE
This attribute refers to the scale of the result of an observation of a diagnostic test (i.e. quantitative, qualitative, semi-quantitative).
Table 154: Permissible values for SCALE TYPE

<table>
<thead>
<tr>
<th>Attribute Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative</td>
</tr>
<tr>
<td>Qualitative</td>
</tr>
<tr>
<td>Ordinal value</td>
</tr>
<tr>
<td>Ordinal or quantitative value</td>
</tr>
<tr>
<td>Nominal value</td>
</tr>
<tr>
<td>Narrative value</td>
</tr>
<tr>
<td>Text value</td>
</tr>
</tbody>
</table>

6.2.3.3.6 MEASUREMENT METHOD
This attribute specifies the method by which a procedure is performed.

Table 155: Permissible values for MEASUREMENT METHOD

<table>
<thead>
<tr>
<th>Attribute Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory procedure categorized by method</td>
</tr>
</tbody>
</table>

For measurement procedures, the attribute | METHOD | is given the value | Measurement - action (qualifier value) |. The attribute | MEASUREMENT METHOD | can be used to provide additional specificity.

6.2.3.3.4 Attribute overlap or interaction
6.2.3.3.4.1 Method vs intent
Some methods intrinsically have intent stated in their name, such as "diagnostic surgical action”.

6.2.3.3.5 Specific procedure types
6.2.3.3.5.1 Surgical procedure
A surgical procedure is defined as a procedure that involves intentional non-transient alteration of structures of the body, and/or a procedure that necessarily involves cutting into the body. From a practical standpoint, this definition is implemented to include all procedures defined by the METHOD attribute with a value of any action that is listed under surgical action.

In SNOMED, operation is synonymous with surgical procedure.

Medical procedure is a deprecated term, because of its clear lack of reproducible meaning. It might be considered to be defined as a procedure done by a physician, but even in this case, it would be deprecated on the basis that it is provider-specific. On the other hand, it seems quite clear (despite some dictionary definitions) that surgical procedures are not defined simply as procedures done by a surgeon; a surgeon can carry out many non-surgical actions (examining patients, prescribing, advising, etc). Even more important, a surgical procedure need not necessarily be performed by a surgeon; if a non-surgeon does a procedure that is surgical, it still remains a surgical procedure.

6.2.3.3.5.1.1 Operation vs. Procedure
While there may never be a complete consensus as to what constitutes a surgical procedure, the agreement has been to classify concepts as surgical procedures if their method is a surgical action based on the action hierarchy. In turn, the surgical action hierarchy distinguishes surgical from non-surgical actions based on the working definition above. Note the or in the sentence: actions that do not involve cutting or incision, but do involve the intentional non-transient alteration of anatomy, are still surgical.
Examples of non-surgical actions include fine-needle or brush biopsies, phlebotomy, aspiration, and closed reduction of dislocations - since they both do not significantly or non-transiently alter anatomy and do not necessarily involve cutting.

Examples of borderline actions that are currently classified as surgical include core needle biopsies - these are more invasive and result in more tissue removal than fine-needle biopsies - and centesis, on the theory that combining puncture with removal alters body structure.

Unresolved issue: fine-needle biopsy could be viewed as a kind of centesis, but the former is non-surgical and the latter is surgical. This appears inconsistent.

Sampling, in general, is not necessarily a surgical action. If what is intended is a sampling that involves surgical removal of part of something, then surgical biopsy action should be the action specified.

6.2.3.3.5.1.2 Surgical Repair

The definition of surgical repair is Restoring, to the extent possible, the natural anatomical structure, using a surgical action. When we clearly distinguish the means by which a procedure is accomplished from the need for the procedure (modelled using the FOCUS attribute), and distinguish these from the objective or intended accomplishment, we can see that repair is clearly an objective or intended accomplishment, not a means (which can be suturing, transplanting, etc) nor a need (normal functioning, cosmetic appearance, pain relief, etc). Although restoring natural structure will be intended to restore natural function and appearance, functional restoration is not necessary for a procedure to be a repair. On the other hand, it is possible to do an operation intended to restore function without restoring structure (such as with surgery to allow attachment of prosthetic limb replacements after amputation) and this type of surgery would not be strictly categorised as a repair.

Since the current model does not have different attributes to distinguish the objective of a procedure from the means used to accomplish it, we continue to use METHOD to model both types of information. If the definition of a procedure requires both a repair action and another action that is not a kind of repair, then two role groups should be used.

6.2.3.3.5.1.3 Plastic operation, -plasty, and plastic repair

The word plastic refers to reshaping, and operations that accomplish a repair (a structural restoration) often use the suffix -plasty. The term plastic repair also occurs, and in order for this not to be a redundancy, there must be a distinction between plastic and repair. The distinction can be found in the contrasting use of the terms plastic and prosthetic. A prosthetic repair uses external (non-body) materials to accomplish the structural restoration, while a plastic repair reshapes the body to accomplish the structural restoration. Plastic repairs therefore are distinguished from general repairs, and distinguished from prosthetic repairs.

The suffix -plasty is widely used in terms that apply to prosthetic repairs (such as in total hip arthroplasty), so we must interpret -plasty to mean any general repair (either prosthetic or plastic or other), and not necessarily just plastic repairs (which reshape existing tissues).

6.2.3.3.5.2 Regimes and Therapies

Regimes and therapies are subtypes of procedure. The Fully Specified Name semantic tag is "(regime/therapy)". This part of the hierarchy contains procedures that are defined as aggregates of sub-procedures which are either: (1) repeated multiple times, over the space of an extended period of time, or (2) are focused on a single purpose but do not have any single sub-procedure as a necessary part. As an example of a "regime" type procedure that has sub-procedures repeated multiple times, consider | antineoplastic chemotherapy regimen |. This term refers to a set of procedures which might include individual instances of administration of a chemotherapy agent, the instances being done at separate times over a pre-determined or planned period of days or weeks. Another example could be "low-dose aspirin therapy for prevention of coronary thrombosis," though this is not currently present in the terminology. In this example, the meaning refers to a repeated administration of aspirin in a small dose, for an indefinite period of time.

An example of a regime/therapy that involves a single purpose but has no defining necessary sub-procedure is | cast care |. In this case, the sub-procedures are all done for the purpose of properly monitoring and maintaining an orthopaedic cast, but the exact sub-procedures done in any one instance may vary from one cast to the next, or from one patient to the next, or from one hospital or care setting to the next. Sub-procedures might include inspection for moisture, examination for cracks, checking skin condition, examining and/or replacing padding, and so forth. The common defining feature is not any one necessary
sub-task, but rather the purpose for which the set of sub-tasks is done - in this case, to take care of an orthopaedic cast.

Regimes/therapies may be the value (the object) of the attribute | has focus |, as in the case of | cardiac rehabilitation assessment |, with | has focus | = | cardiac rehabilitation (regime/therapy) |. They may also be the subject of | has focus |, as in the case of | occupational therapy surveillance (regime/therapy) | with | has focus | = | occupational therapy (regime/therapy) |.

6.2.3.3.5.2.1 Navigational concepts versus regimes or therapies

To tell the difference between a disjunctive/navigational procedure and a regime, ask whether an instance of this category would be a set of procedures done on a single patient (in which case it is a regime), or instead is a single procedure done on a single patient (in which case it is disjunctive/navigational). The instances of a disjunctive or navigational procedure category (the acts in reality that the category refers to) represent one particular procedure that is done on one particular patient. A disjunctive/navigational term example is “excision of lesion of ear, nose, or throat”. The excision of a lesion from the nose of Mr. Smith on April 23rd would be an instance (individual) belonging to the class “excision of lesion of ear, nose, or throat”. In contrast, the instances of a regime are sets, sequences or groups of procedures. For example, an instance of "cast care" could be the specific cast care for Mr. Smith's cast on the morning of April 23rd, consisting of the set of procedures: (1) examining the cast; (2) examining his arm; (3) asking for his symptoms; and (4) cleaning the skin. It is possible to have an instance of cast care in which the set includes only one procedure (e.g. examining Mr. Smith's cast), but regimes must have the ability to reference an instance consisting of a set of multiple procedures, while disjunctive categories reference instances that are single.

6.2.3.3.5.3 Endoscopy, endoscopic procedures

Endoscopic procedures are distinguished from endoscopy procedures. The chief distinction depends on the main action (METHOD). If the main action is inspection using an endoscope, this is an endoscopy. If the main action is some other value for METHOD that is carried out by gaining access to the procedure site via an endoscope, this is an endoscopic procedure, and it is modelled with USING ACCESS DEVICE to specify that the endoscope is used to access the site. The main action of an endoscopic procedure is not the action of inspection with the endoscope. Therefore, the action of inspecting using the endoscope is not modelled unless the FSN also specifies endoscopy or inspection. For procedures where the emphasis is on inspection using a device (e.g. endoscopy), the attribute USING DEVICE is used instead of USING ACCESS DEVICE.

6.2.3.3.5.4 Centesis procedures

Centesis may be defined as the act of puncturing a body cavity or space with a hollow needle and drawing out fluid. Each centesis procedure thus involves both a puncture action and a needle aspiration action. It is correct to have two role groups for centesis procedures. One group has a METHOD equal to puncture action and a PROCEDURE-SITE DIRECT equal to the structure being punctured. For thoracentesis, the direct site would be the pleura. The second role group has a METHOD equal to aspiration action and has a PROCEDURE-SITE INDIRECT equal to the space being aspirated. For thoracentesis, the indirect site would be the pleural cavity.

The value centesis action should be retired and not used, since it is actually two different actions with different direct and indirect objects.

6.2.3.3.5.5 Transplantation and grafting

Transplantation and grafting have very similar meanings, but they are not the same. Some procedures are both transplantation and grafting. Some are grafting but not transplantation, and some are transplantation but not grafting.

Grafting includes procedures that are not transplantation: The noun graft might be defined as any free (unattached) tissue or organ for transplantation. However, over time the meaning has been extended to include artificial grafts and implants that are not biological in origin. On the other hand, transplantation has not acquired this extended meaning; all transplants consist of biological material.

In the action hierarchy, grafting is defined as a kind of surgical introduction. Thus all procedures defined with the action grafting action will be surgical procedures.

Transplantation includes procedures that are not grafting: The action grafting necessarily implies that the action by the performer of the deed involves attachment or fixation of the (biological or artificial) graft into its place in the recipient. Most transplantations also involve such attachment or fixation, but not all. Most
notably, bone marrow and stem cell transplantation does not involve the action of attachment or fixation. Rather, the action or deed is merely infusion. The infused cells individually find their way to the bone marrow or other sites where conditions are right for their growth and differentiation.

In the action hierarchy, transplantation is not a kind of surgical action. If it were, then bone marrow transplantation would be a surgical procedure, but it clearly is not.

Summary: Procedures that involve the attachment or fixation of biological tissue are both kinds of grafting and kinds of transplantation. If the grafted material is not biological, then the procedure cannot be a type of transplantation. If the transplanted material is not attached or fixed in place, then the procedure cannot be a type of grafting.

6.2.3.3.5.6 Measurement procedures and laboratory procedures

Measurements are observations that designate the value of a property, quality or attribute that is inherent in the individual or population (or their specimens, by proxy), according to specified rules. Although measurement is generally considered to be the observation of a quantitative value for a quality or attribute, measurements need not necessarily result in a numeric or ordinal result. In other words, detection (detected/not detected) and identification (selection of one or more possibilities from a specified set by detecting their presence or absence) are considered types of measurement procedures. This is admittedly a broad definition, but does require that measurement procedures be done according to pre-determined rules and that they specify the property, quality or attribute that is being measured. Measurement can definitely be done by physical examination techniques as well as by laboratory techniques, but physical examination by itself is not a kind of measurement. Of course, several of the routine procedures carried out during a physical examination involve measurements of properties such as height, weight, vital signs, range of motion, deep tendon reflexes, etc. However, the interpretation of primary observations as being normal or abnormal is not considered a kind of measurement, since normality is not an inherent property, quality or attribute that can be measured but rather a second-level interpretation of where the primary value lies relative to a range determined externally to the individual.

6.2.3.3.5.6.1 Laboratory procedures

The difference between a measurement and a laboratory measurement is difficult to reproducibly define. Common language convention allows the category lab tests to include procedures like prothrombin time (PT or INR), even when the test is not performed in a laboratory. Diabetics routinely measure their blood glucose are they doing a lab test? Bedside testing and intraoperative testing are expanding, and blurring the distinction between what is done in a laboratory and what is not. As a result, measurement procedure is to be preferred for naming procedures that measure all types of analytes. The term lab test should be regarded as a useful grouper for interface terminology, but not as a necessary definitional supertype of measurements that are ordinarily done in a hospital laboratory (since they might also be done in a non-laboratory setting).

Measurement procedure concepts that do not otherwise specify should be assumed to refer to the entire process of measurement, which may include obtaining an appropriate specimen, preparing the specimen, and carrying out the analysis and reporting the result. These procedure codes do not narrowly refer only to an intra-laboratory activity. In other words, unless otherwise specified, the tests are named primarily from the perspective of what is done for the patient (what is measured), rather than from the perspective of what each health care worker does to accomplish the task.

Likewise, non-measurement procedures involving patient specimens should be regarded as referring to the entire procedure that is done for that patient. The difference this makes inmodelling is that we should not add an attribute-value pair that means done in a laboratory in order to define these procedures (not even as necessarily also conditions).

Examples:

Serum sodium measurement [104934005 | Sodium measurement, serum ]: This procedure concept refers to a sequence of actions that may include obtaining the specimen (if necessary - but may not be if measured by an intravascular device), preparing the specimen, running the test, and reporting the result.

PAP test [119252009]: This concept refers to a sequence of actions including obtaining the specimen, making the smear, staining, screening, interpreting and reporting.

Preparation of cytologic smear from genital source [90226004 | Cytopathology procedure, preparation of smear, genital source ]: This is the smear preparation only, which includes staining if staining is done,
but excludes obtaining the specimen, examining the slide microscopically, interpreting the findings, or reporting.

6.2.3.3.5.7 Radiographic procedures

| Radiographic imaging procedure | [363680008 | Radiographic imaging procedure ] was created as the top of a hierarchy of imaging procedures utilising x-rays. | Diagnostic radiologic examination | [38743002] had a synonym of “X-ray”, but this code has been retired because it may have been interpreted more narrowly, in particular because of the possibly narrower interpretation of radiologic versus radiographic, and the possibly narrower interpretation of diagnostic. Nevertheless, the phrase “diagnostic radiography is allowed in many of the FSNs of subtypes of | radiographic imaging procedure |.

6.2.3.3.5.8 Imaging guidance procedures

The imaging guidance aspect of procedures can be modelled using the existing attribute HAS INTENT. The concept | guidance intent (qualifier value) |, a child of | Intents (nature of procedure values) (qualifier value) |, was created to be the value for HAS INTENT for imaging guided procedures.

Example:

Computerised tomography guided biopsy of brain (procedure)

- Role Group 1
  - METHOD: Biopsy - action (qualifier value)
  - PROCEDURE SITE-DIRECT: Brain structure (body structure)

- Role Group 2
  - METHOD: Computed tomography imaging - action (qualifier value)
  - PROCEDURE SITE-DIRECT: Brain structure (body structure)
  - HAS INTENT: Guidance intent (qualifier value)

Computerised tomography guided biopsy of brain (procedure) would then be subsumed by Biopsy of brain (procedure) and by Computerised axial tomography of brain (procedure).

The term "Fluoroscopic Y" will be interpreted as meaning "Y using fluoroscopic guidance (procedure)".

Procedures such as | Biopsy of wrist using fluoroscopic guidance (procedure) | will be subtypes of | Fluoroscopy (procedure) |.

6.2.3.3.5.9 Procedure on bone - Procedure on skeletal system

There are five anatomical concepts related to “bone”.

1. Bone (tissue): the tissue type that makes up bones.
2. Bone (organ): individual particular bones, such as femur, fibula, ulna, scaphoid, lunate, etc.
3. Skeletal system subdivision: groupings of bones taken together, such as spine, skull, bony pelvis.
4. Bone (system): the pars ossea systematis skeletalis, the bone part of the skeletal system
5. Skeletal system: the entire skeletal system, including both the bones and the part of the skeleton composed of cartilage.

Because bone (tissue) is part-of bone (organ), and bone (organ) is part-of bone (system), we can use bone (system) to define aggregate terms that involve bones. Since the skeletal system includes the bones and cartilage of the skeleton, it may be possible to have a procedure on the skeletal system that is not a procedure on bone.

[Note: For now, we have made "skeletal system subdivision" also a part-of bone (system). This may need to change if there are procedures on cartilaginous skeleton that involve skeletal system subdivisions.]

6.2.3.3.5.10 Repair of fistula Closure of fistula

These are considered to have the same meaning, because closure - action is a kind of repair action, and because repair of a fistula involves closing it. In other words, all fistula closures are auto-classified as kinds of repair procedures, and we model all fistula repairs using closure action.

6.2.3.3.5.11 Excisional Incisional ectomy, Excision, total excision, partial excision

These terms are sometimes very difficult to interpret. We have organised excisions of or from organs according to the following general structure:
• [Organ] excision = any excisional act involving the organ (usually [organ]-ectomy is a synonym, but see next)
  • Complete excision of [organ] (sometimes [organ]-ectomy)
    • Excisional biopsy of entire [organ] (e.g. lymph nodes, testis, ovaries)
  • Partial excision of [organ]
    • Excision of lesion from [organ] (may be partial or complete removal of lesion)
      • Incisional biopsy of [organ] = incisional biopsy of lesion of [organ]
      • Excisional biopsy of [organ] structure (excisional biopsy of lesion of [organ], excisional biopsy of tissue of [organ])

• Biopsy
  • Open biopsy (biopsy done by open approach; usually is incisional)
  • Incisional biopsy
  • Excisional biopsy
    • Excisional biopsy (entire [organ])
    • Excisional biopsy (lesion)

Notes on the structure:
1. “[Organ]” is a generic placeholder for any particular organ.
2. “[Organ] excision” does not specify whether it is complete or partial, nor does it specify what is excised.
3. Sometimes, the -ectomy word is a synonym of complete removal; when it is, the full name will specify “complete organ-ectomy”.
4. An excision is not necessarily a biopsy, nor are all biopsies excisions (e.g. brush biopsy).
5. | Incisional biopsy of [organ] | necessarily implies incision and removal of a lesion, and is by definition a partial excision, since the site is the organ, and an excision is done, but the entire lesion is not necessarily removed.
6. | Excisional biopsy of [organ] | generally means that tissue or a lesion or suspected lesion is necessarily entirely excised, not the entire organ, except in the case of small endocrine glands and lymph nodes, in which an excisional biopsy takes the entire gland.
7. An excisional biopsy of a lesion of an organ is a partial excision of (from) the organ. This is true even when small polyps are removed. Specifying “partial excision” does not differentiate between those excisions that remove irreplaceable tissue and those that do not (e.g. a segmental resection vs polypectomy of intestines).

6.2.3.3.5.11.1 Biopsy and Excision

Biopsies, like other removals, can have two direct objects, one the morphology and the other the site. It is therefore alright to use | Procedure site - Direct | for biopsies, even if subtypes might have a direct object that is a morphology.

6.2.3.3.5.12 Immunisation and Vaccination

Immunisation may be accomplished by active immunisation (introduction of a vaccine), or by passive immunisation (introduction of immunoglobulin / antibodies). Vaccination, by definition, is the introduction of a vaccine, and is therefore synonymous with active immunisation, since a vaccine is a substance that can induce active immunity. We have changed the preferred name of some terms that formerly said “immunisation” to be “vaccination”, where it is clear that vaccination was intended. In other cases, we have created a new subordinate term for vaccination, and left the original immunisation term as a superordinate term to encompass both active and passive immunisation procedures.

6.2.3.3.5.13 Division, incision, transection, bisection, and osteotomy

Division action is defined as a subtype of | Incision - action |. This does not necessarily mean that all procedure names that include the word division are necessarily to be modelled with | METHOD | = division-action.
The exception is those procedures where the division is accomplished using blunt dissection and not incision. For example, division of adhesion concepts should be modelled the same was as lysis of adhesions procedure concepts using dissection - action. Adhesions are broken down by blunt dissection, often without incising them, though in an open-world model this does not exclude procedures that may also involve division by incision.

The preferred name of the division of adhesion concepts can be changed to lysis of adhesions for the sake of consistency and to avoid the incorrect modelling that might occur from interpreting these divisions as necessarily being kinds of incision.

6.2.3.3.5.13.1 Transection and bisection

Transection is a division across the longitudinal axis of a structure. Bisection is division into two parts by cutting. The action concept Transection - action is a subtype of bisection action, which in turn is a subtype of division action, and is also a subtype of Incision - action.

This assumes that transection is accomplished by cutting.

6.2.3.3.5.13.2 Osteotomy

One definition of the word osteotomy is cutting into or through a bone. This creates three possible meanings in the terminology:

1. Cutting into a bone, regardless of whether the bone is divided thereby (general concept)
2. Cutting through a bone and dividing it
3. Cutting into a bone without cutting through it and therefore without dividing it (incision without division)

The first meaning, incision, is to be modelled using METHOD = incision action, and PROCEDURE-SITE-DIRECT = bone structure (or subtypes). The second meaning, division by cutting, is to be modelled using METHOD = division action, and PROCEDURE-SITE-DIRECT = bone structure (or subtypes). The third meaning, incision without division, does not appear to be needed. Those procedures that do not explicitly involve division can be modelled as simply incision. Any incision procedure that necessarily must not involve division (as opposed to ordinarily would not involve division) would have to remain primitive until such time as a negation operator is added to the logic repertoire.

Osteotomy - action (qualifier value) is regarded as ambiguous and should be (or remain) retired.

Incision of bone had a synonym of incision of bone without division, but it cannot retain this synonym and at the same time retain division of bone as its subtype. Therefore this synonym is retired as not valid.

6.2.3.3.5.14 Open reduction and internal fixation (ORIF)

This phrase includes two accomplishments (reduction and fixation) which are accomplished by two different means (open manipulation of the fracture, and insertion of an orthopaedic fixation device). This provides a clear opportunity for general concept inclusion axioms (GCIs) in order to fully represent the meanings without imposing a heavy modelling burden on those who do postcoordination.

The simplest path is to say that open reduction of a fracture necessarily involves open manipulation of the fracture; and that internal fixation of a fracture necessarily involves the insertion of an orthopaedic internal fixation device.

6.2.3.3.5.15 Encounter

An encounter is defined as an in-person meeting between a patient and a health care provider for the purpose of the provision of health care services to the patient. These are defined as kinds of procedure.

An indirect encounter is not actually an encounter, since there is no face-to-face meeting. Therefore encounter and indirect encounter are siblings in the procedure hierarchy.

6.2.3.3.6 Changes and historical notes

6.2.3.3.6.1 Surgical procedures in Clinical Terms version 3

The surgical and related procedure domains in Clinical Terms Version 3 was generated from the OPCS4-based Chapter 7 of Read Version 2 by the addition of new concepts during the Clinical Terms Project (CTP) and subsequent refinement.
6.2.3.6.2 ROUTE OF ADMINISTRATION added

This attribute was added in the January 2006 release to allow a procedure to be more fully modelled so that its definition includes the route of administration of a given substance.

6.2.3.6.3 USING DEVICE replaced USING

| USING DEVICE | replaced the attribute | USING | which was retired as of the January 2007 release. The retired attribute | USING | allowed values that included descendants of | Physical force (physical force) | which are not actually devices. Additionally, the new | DEVICE | attributes are intended to clarify the inconsistency that existed over when to use the attribute | USING | versus | ACCESS INSTRUMENT | versus | ACCESS |, particularly for | Endoscopic procedure |.

6.2.3.6.4 ACCESS | not used to model endoscopic route of access

As of the January 2007 release, | ACCESS | was no longer used to capture the fact that the route used to access a procedure was endoscopic. The information that was previously captured by | ACCESS | | Endoscopic approach-access (qualifier value) | is adequately captured with | USING ACCESS DEVICE | | Endoscope, device (physical object) |.

6.2.3.6.5 USING SUBSTANCE and USING ENERGY added

These attributes were introduced in the January 2007 release.

6.2.3.6.6 APPROACH retired

The attribute APPROACH was retired for the January 2008 releases because its use for non-surgical procedures was not reproducible

6.2.3.4 Observable Entities

The observable hierarchy is currently at the top level, with several immediate groupers as children:

• SNOMED CT concept
  • observable entity
    • age AND/OR growth period
    • body product observable
    • clinical history/examination observable
    • device observable
    • drug therapy observable
    • environment observable
    • feature of entity
    • function
    • general clinical state
    • haematology observable
    • identification code
    • imaging observable
    • interpretation of findings
    • molecular, genetic AND/OR cellular observable
    • monitoring features
    • population statistic
    • process
    • radiation therapy observable
    • sample observable
    • social / personal history observable
    • substance observable
    • temporal observable
    • tumour observable
    • vital signs
Observables are considered to be partial observation results, where there is a defined part of the observation missing. In many cases, what is missing is a numeric value, or a numeric value with units. In other cases, the observable is like a question, and what is missing can be regarded as the answer.

Among the immediate children of observable entity, some of the categories are now regarded as not fitting this definition and therefore should be moved. At a minimum, | function | and | process | are in this group that clearly needs to be moved.

6.2.3.4.1 Observable entity

Concepts in this hierarchy can be thought of as representing a question or procedure which can produce an answer or a result. For instance, | Left ventricular end-diastolic pressure (observable entity) | could be interpreted as the question, “What is the left ventricular end diastolic pressure?” or “What is the measured left ventricular end-diastolic pressure?”

Observables are entities that could be used to code elements on a checklist or any element where a value can be assigned. | Color of nail (observable entity) | is an observable. | Gray nails (finding) | is a finding.

One use for | Observable entity | in a clinical record is to code headers on a template. For example, | Gender (observable entity) | could be used to code a section of a template titled “Gender” where the user would choose “male” or “female”. “Female gender” would then constitute a finding.

Note: See also Attributes used to define Evaluation Procedure concepts.

6.2.3.4.2 Observable Entities and Evaluation Procedures

The concept models for observable entities and evaluation procedures are tightly linked. They employ the same set of attributes, with the exception that evaluation procedures also use METHOD. In terms of creation of codes, there will not necessarily be a one-to-one correspondence between the two hierarchies. Not every evaluation procedure will have a corresponding observable entity, and neither will every observable entity have a corresponding evaluation procedure.

The addition of new laboratory observables and procedures is subject to a Cooperative agreement with Regenstrief Institute / LOINC, which requires that there be a formal request from more than one IHTSDO Member Country before adding new SNOMED CT content that is covered by the agreement. The purpose is to minimize unnecessary duplication of effort between SNOMED CT and LOINC.

Note: At the time of publication of this guide, the concept model for observables has not yet been adopted for use with the released observables hierarchy; and some of the defining attributes (object properties) listed here have not yet been added to SNOMED CT in the concept model attributes hierarchy.

6.2.3.4.2.1 Evaluation Procedures

The evaluation procedure hierarchy is currently classified under "procedure by method", with several immediate groupers as children::

- Procedure by method
  - evaluation procedure
    - measurement
    - physical examination
    - monitoring
    - imaging
    - spectroscopy

Evaluation procedures can be defined by METHOD = evaluation - action in the general case. Subtypes of evaluation - action are used to define other subtypes of evaluation procedure according to a few action values: measurement, physical examination (in the medical sense of using direct inspection, palpation, percussion or auscultation), monitoring (a set of temporally repeated evaluations), imaging (the creation and evaluation of an image), or spectroscopy (the detection and evaluation of a spectrum).
6.2.3.4.3 Attributes for observable entities and evaluation procedures

6.2.3.4.3.1 Observable entity and evaluation procedure attributes: overview

Table 156: Observable entity and evaluation procedure attributes summary

<table>
<thead>
<tr>
<th>DEFINING ATTRIBUTE</th>
<th>Permissible Values (Concepts listed and their descendants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROPERTY TYPE</td>
<td>Property</td>
</tr>
<tr>
<td>INHERES IN</td>
<td>Body structure</td>
</tr>
<tr>
<td></td>
<td>Physical object</td>
</tr>
<tr>
<td>INHERENT LOCATION</td>
<td>Body structure</td>
</tr>
<tr>
<td>INHERENT INGREDIENT</td>
<td>Substance</td>
</tr>
<tr>
<td>CHARACTERIZES</td>
<td>Process</td>
</tr>
<tr>
<td>PROCESS AGENT</td>
<td>Body structure</td>
</tr>
<tr>
<td>PROCESS DURATION</td>
<td>Time frame</td>
</tr>
<tr>
<td>PROCESS OUTPUT</td>
<td>Substance</td>
</tr>
<tr>
<td>TOWARDS</td>
<td>Body structure</td>
</tr>
<tr>
<td></td>
<td>Physical object</td>
</tr>
<tr>
<td>RELATIVE TO</td>
<td>Substance</td>
</tr>
</tbody>
</table>
### Table 6.2.3.4.3.2 Property Type

<table>
<thead>
<tr>
<th>DEFINING ATTRIBUTE</th>
<th>Permissible Values (Concepts listed and their descendants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>REL-TO PART-OF</td>
<td>Body structure 123037004</td>
</tr>
<tr>
<td></td>
<td>Organism 410607006</td>
</tr>
<tr>
<td></td>
<td>Substance 105590001</td>
</tr>
<tr>
<td></td>
<td>Specimen 123038009</td>
</tr>
<tr>
<td></td>
<td>Physical object 260787004</td>
</tr>
<tr>
<td></td>
<td>Pharmaceutical / biologic product 373873005</td>
</tr>
<tr>
<td></td>
<td>Record artifact 419891008</td>
</tr>
<tr>
<td>PRECONDITION</td>
<td>Clinical finding 404684003</td>
</tr>
<tr>
<td></td>
<td>Precondition value 703763000</td>
</tr>
<tr>
<td>SCALE</td>
<td>Quantitative 30766002</td>
</tr>
<tr>
<td></td>
<td>Qualitative 26716007</td>
</tr>
<tr>
<td></td>
<td>Ordinal value 117363000</td>
</tr>
<tr>
<td></td>
<td>Ordinal or quantitative value 117365007</td>
</tr>
<tr>
<td></td>
<td>Nominal value 117362005</td>
</tr>
<tr>
<td></td>
<td>Narrative value 117364006</td>
</tr>
<tr>
<td></td>
<td>Text value 117444000</td>
</tr>
<tr>
<td>UNITS</td>
<td>Unit 258666001</td>
</tr>
<tr>
<td>TECHNIQUE</td>
<td>Technique (qualifier value) 272394005</td>
</tr>
<tr>
<td>DIRECT SITE</td>
<td>Body structure 123037004</td>
</tr>
<tr>
<td></td>
<td>Organism 410607006</td>
</tr>
<tr>
<td></td>
<td>Physical object 260787004</td>
</tr>
<tr>
<td></td>
<td>Specimen 123038009</td>
</tr>
</tbody>
</table>

**Note:**

Permissible values for these attributes include the concepts listed and their descendants.

**6.2.3.4.3.2 Property Type**

This attribute is used to specify the type of inherent quality or process that is to be observed. Its values are abstract types of quality (length, odour, concentration) or abstract types of process features (rate, speed), and do not include qualities that are located (length of arm, odour of urine), or given a value (elevated concentration).
### Table 157: Permissible values for Property Type

<table>
<thead>
<tr>
<th>Concept</th>
<th>Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Property type (qualifier value)</td>
<td>![new]</td>
</tr>
<tr>
<td></td>
<td>Measurement property</td>
<td>118598001</td>
</tr>
<tr>
<td>Blood glucose mass concentration (observable entity)</td>
<td>![PROPERTY TYPE]</td>
<td>![mass concentration (property)]</td>
</tr>
<tr>
<td>![TOWARDS]</td>
<td>![glucose (substance)]</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

In a coming release of SNOMED CT, Measurement property will become a subtype of a new general concept.

### 6.2.3.4.3.3 Inheres In

This attribute specifies the independent continuant in which the quality inheres, and on which the dependent quality (of this observable) depends.

### Table 158: Permissible values for Inheres In

<table>
<thead>
<tr>
<th>Concept</th>
<th>Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body structure</td>
<td>123037004</td>
</tr>
<tr>
<td>Catalytic activity content of alpha-L-iduronidase in fibroblasts (observable entity)</td>
<td>![PROPERTY TYPE]</td>
<td>![catalytic activity content]</td>
</tr>
<tr>
<td>![INHERES IN]</td>
<td>![fibroblast (cell)]</td>
<td></td>
</tr>
<tr>
<td>![TOWARDS]</td>
<td>![L-Iduronidase (substance)]</td>
<td></td>
</tr>
<tr>
<td>![DIRECT SITE]</td>
<td>![fibroblast specimen]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organism</td>
<td>410607006</td>
</tr>
<tr>
<td>Moxalactam susceptibility MLC (observable entity)</td>
<td>![PROPERTY TYPE]</td>
<td>![susceptibility]</td>
</tr>
<tr>
<td>![INHERES IN]</td>
<td>![bacterium]</td>
<td></td>
</tr>
<tr>
<td>![TOWARDS]</td>
<td>![moxalactam (substance)]</td>
<td></td>
</tr>
<tr>
<td>![TECHNIQUE]</td>
<td>![minimum lethal concentration (technique)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Substance</td>
<td>105590001</td>
</tr>
<tr>
<td>Glutamine substance concentration in plasma (observable entity)</td>
<td>![PROPERTY TYPE]</td>
<td>![substance concentration]</td>
</tr>
<tr>
<td>![INHERES IN]</td>
<td>![plasma (substance)]</td>
<td></td>
</tr>
<tr>
<td>![TOWARDS]</td>
<td>![glutamine (substance)]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Specimen</td>
<td>123038009</td>
</tr>
<tr>
<td>Volume of 24-hour urine sample (observable entity)</td>
<td>![PROPERTY TYPE]</td>
<td>![volume]</td>
</tr>
<tr>
<td>![INHERES IN]</td>
<td>![24 hour urine sample (specimen)]</td>
<td></td>
</tr>
</tbody>
</table>
### Examples

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical object</td>
<td>260787004</td>
</tr>
<tr>
<td>Pharmaceutical / biologic product</td>
<td>373873005</td>
</tr>
<tr>
<td>Record artifact</td>
<td>419891008</td>
</tr>
</tbody>
</table>

#### 6.2.3.4.3.4 Inherent Location

This attribute is used to specify a body site or other location of the independent continuant in which the property inheres.

**Table 159: Permissible values for Inherent Location**

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body structure</td>
<td>123037004</td>
</tr>
<tr>
<td>Organism</td>
<td>410607006</td>
</tr>
<tr>
<td>Physical object</td>
<td>260787004</td>
</tr>
</tbody>
</table>

#### 6.2.3.4.3.5 Inherent Ingredient

This attribute is used to specify the ingredient substance type of the independent continuant in which the property inheres.

**Table 160: Permissible values for Inherent Ingredient**

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001</td>
</tr>
</tbody>
</table>

#### 6.2.3.4.3.6 Characterizes

This attribute specifies the process which the property describes, and on which the property (of this observable) depends. The process can be very general (e.g. "excretion").
Table 161: Permissible values for Characterizes

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>415178003</td>
</tr>
<tr>
<td></td>
<td>PROPERTY TYPE</td>
</tr>
<tr>
<td></td>
<td>CHARACTERIZES</td>
</tr>
<tr>
<td></td>
<td>PROCESS DURATION</td>
</tr>
<tr>
<td></td>
<td>PROCESS OUTPUT</td>
</tr>
<tr>
<td></td>
<td>RELATIVE TO</td>
</tr>
<tr>
<td></td>
<td>DIRECT SITE</td>
</tr>
</tbody>
</table>

6.2.3.4.3.7 Process agent

This attribute is used to specify the continuant (such as a body structure or organism) that is causally active in the process on which the property depends. It appears to have the same meaning as 'has_agent' in the OBO Relations Ontology. It may specialise the meaning of the process named as the value of CHARACTERIZES, or it may simply recapitulate the meaning that is already there. The PROCESS AGENT can be left unspecified.

Table 162: Permissible values for Process agent

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body structure</td>
<td>123037004</td>
</tr>
<tr>
<td></td>
<td>PROPERTY TYPE</td>
</tr>
<tr>
<td></td>
<td>CHARACTERIZES</td>
</tr>
<tr>
<td></td>
<td>PROCESS AGENT</td>
</tr>
<tr>
<td></td>
<td>PROCESS OUTPUT</td>
</tr>
<tr>
<td></td>
<td>PRECONDITION</td>
</tr>
<tr>
<td>Organism</td>
<td>410607006</td>
</tr>
</tbody>
</table>

6.2.3.4.3.8 Process duration

This attribute specifies the duration of the process characterised by the observable property type.

Table 163: Permissible values for Process duration

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time frame (qualifier value)</td>
<td>7389001</td>
</tr>
<tr>
<td></td>
<td>PROPERTY TYPE</td>
</tr>
<tr>
<td></td>
<td>CHARACTERIZES</td>
</tr>
<tr>
<td></td>
<td>PROCESS OUTPUT</td>
</tr>
<tr>
<td></td>
<td>PROCESS DURATION</td>
</tr>
<tr>
<td></td>
<td>DIRECT SITE</td>
</tr>
</tbody>
</table>
6.2.3.4.3.9 Process output

This attribute specifies the substance produced by the process characterised by the observable property type.

Table 164: Permissible values for Process output

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Towards

This attribute is used to specify the third element of a relational quality, the first two elements being the type of property and the entity in which the quality inheres.

Table 165: Permissible values for Towards

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body structure</td>
<td>123037004</td>
</tr>
<tr>
<td>Organism</td>
<td>410607006</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Substance</td>
<td>105590001</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen</td>
<td>123038009</td>
</tr>
<tr>
<td>Physical object</td>
<td>260787004</td>
</tr>
<tr>
<td>Pharmaceutical / biologic product</td>
<td>373873005</td>
</tr>
<tr>
<td>Record artifact</td>
<td>419891008</td>
</tr>
</tbody>
</table>

6.2.3.4.3.11 Relative To

This attribute is used to specify the denominator of a relational property type, such as a ratio or proportion.
6.2.3.4.3.12 RelTo Part of

This attribute specifies the independent continuant which the value of “relative to” is part of, if different from the independent continuant in which the property type inheres. Its main use is for relative substance concentrations, where the same substance has a concentration in two different fluids. In this case, TOWARDS and RELATIVE TO will have the same substance value, and the two fluids will be represented as values of INHERES IN and REL-TO PART OF.

Table 167: Permissible values for Rel To Part of

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen</td>
<td>123038009</td>
</tr>
<tr>
<td>Physical object</td>
<td>260787004</td>
</tr>
<tr>
<td>Pharmaceutical / biologic product</td>
<td>373873005</td>
</tr>
<tr>
<td>Record artifact</td>
<td>419891008</td>
</tr>
</tbody>
</table>
6.2.3.4.3.13 Precondition

This attribute is used to specify body state, timing, challenges, and other situations that must be true of the entity to be observed.

Table 168: Permissible values for Precondition

<table>
<thead>
<tr>
<th>Concept</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precondition value</td>
<td>703763000</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical finding</td>
<td>404684003</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.4.3.14 Scale type

This attribute refers to the scale of the result of an observation or a diagnostic test (i.e., quantitative, qualitative, semi-quantitative).

Table 169: Permissible values for Scale type

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative (qualifier value)</td>
<td>30766002</td>
</tr>
<tr>
<td>Qualitative</td>
<td>26716007</td>
</tr>
<tr>
<td>Ordinal value</td>
<td>117363000</td>
</tr>
<tr>
<td>Ordinal or quantitative value</td>
<td>117365007</td>
</tr>
<tr>
<td>Nominal value (qualifier value)</td>
<td>117362005</td>
</tr>
<tr>
<td>Narrative value (qualifier value)</td>
<td>117364006</td>
</tr>
<tr>
<td>Text value</td>
<td>117444000</td>
</tr>
</tbody>
</table>

6.2.3.4.3.15 Units

This attribute represents the units used in assigning a value to an observation.

Table 170: Permissible values for Units

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>258666001</td>
</tr>
</tbody>
</table>
6.2.3.4.3.16 Technique

This attribute links concepts in the | Observable entity | hierarchy to their related | Technique |.

Table 171: Permissible values for Technique

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techniques values (qualifier value)</td>
<td>272394005</td>
</tr>
<tr>
<td>Techniques</td>
<td></td>
</tr>
</tbody>
</table>

Note:

In a coming release of SNOMED CT, | Techniques values (qualifier value) | will have a number of new values added.

6.2.3.4.3.17 Direct Site

Direct site represents the specific entity on which the observation is directly made, and is used when the observation is indirect, such as when a direct observation is not possible to be done on the entity in which the observable inheres.

Table 172: Permissible values for Direct Site

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body structure</td>
<td>123037004</td>
</tr>
<tr>
<td>Organism</td>
<td>410607006</td>
</tr>
<tr>
<td>Physical object</td>
<td>260787004</td>
</tr>
<tr>
<td>Specimen</td>
<td>123038009</td>
</tr>
</tbody>
</table>

6.2.3.4.4 Converting LOINC or NPU codes into observable entities

6.2.3.4.4.1 Rules for converting LOINC names into observable entities

These rules are being developed and reviewed in collaboration with the Regenstrief Institute and LOINC, as part of a cooperation project. The rules are subject to change as the project progresses.

1. For peak and trough level measurements: COMPONENT = substance, and PRECONDITION = At time of peak level [or At time of trough level]
2. The single point in time value in the TIMING part of LOINC terms is already implied by the observable model, which refers to entities that exist at a single point in time. As a result, an additional object property is not needed in the observables model to represent the TIMING of a single point in time. In the case of tests that have TIMING values that extend across time, the object property PROCESS DURATION is used.
3. The LOINC part "Patient" is already implied in the observables model and is not explicitly modeled. If the observable refers to someone or something other than the patient, this will be explicitly represented.
4. For antibiotic susceptibility: PROPERTY-TYPE= susceptibility, and INHERES-IN = Organism [or subtype of organism]
5. If the specimen is serum or serum/plasma, INHERES-IN = plasma
6. If LOINC component ends with .RAST class, this represents a kind of score. It is still the technique, but it is not "radioallergosorbent technique", rather it is "RAST scoring" technique.
7. For cell antigen measurements, if the PROPERTY-TYPE is arbitrary concentration, then InheresIn should take a value = population of cells (or population of the appropriate subtypes of cell, e.g. population of erythrocytes, population of neutrophils, etc.)
8. For fractions and ratios, the LOINC component is split into TOWARDS and RELATIVE-TO
9. When LOINC system = xxx, INHERES-IN has no value – it remains null, and DIRECT-SITE = specimen
10. Challenge information is extracted from Component, and put in PRECONDITION.
a. The LOINC “xxx” is not included in the string for PRECONDITION values.

11. Ratios and fractions are split, the “numerator” substance is put in the TOWARDS field and “denominator” substance is put in the RELATIVE-TO field
   a. The values put into TOWARDS and RELATIVE-TO are the codes for substances, not the codes for concentrations of the substances
   b. For RELATIVE-TO values, “total amount” is assumed, and the word “total” need not be added to the substance term.

12. Impression/interpretation is a valid value of PROPERTY-TYPE, but the rest of the model does not fit and therefore these terms require an expanded model (i.e. they must remain incompletely modelled at present).

13. When PROPERTY-TYPE is a feature of a process, use CHARACTERIZES instead of INHERES-IN, and the value of CHARACTERIZES is a process.
   a. Catalytic activity (and catalytic activity ratio) is measured in the lab by a process of actual catalysis by the enzyme in the sample; but the observable is intended to characterise a specifically dependent continuant, which is in this case a disposition: the point-in-time catalytic disposition of the existing quantity of enzyme in the plasma at the point in time the sample is drawn. The observable is not intended to characterise a process of catalysis that extends over time in the patient (if it were, multiple samples over time would be necessary).

14. For coagulation, many subtleties can be avoided by simply naming the TECHNIQUE. For example, the International Normalised Ratio (INR) test has TECHNIQUE = INR.

15. When LOINC system = dose, the PROPERTY-TYPE (e.g. mass) INHERES-IN the LOINC component, (put the LOINC component value into the INHERES-IN field). This is the active ingredient of the substance that is administered, and it is the amount of the active ingredient which is the value of the observable.

16. When measuring the total of two types of cells, the TOWARDS should be a single value representing the disjunctive category (“cell type A or cell type B”).

17. HLA antigen measurements should modelled as INHERES-IN = 108353004 cell surface structure. If the test is done on leukocytes, then SPECIMEN = 258591005 white blood cell sample.

18. For microbiology organism presence/identity observables, the component is split into PROPERTY-TYPE = Linnaean taxon, INHERES-IN = organism (or bacterium, virus, fungus, protozoan, etc if known prior to testing), and INHERES-IN-LOCATION = site of the culture. PRECONDITION is used to specify which one of a series of organisms is being identified.

19. For titers (titres), the PROPERTY-TYPE is arbitrary concentration, and the TECHNIQUE is titration (or a subtype thereof).

20. If LOINC system = XXX, DIRECT-SITE and/or INHERES-IN may be null (i.e. not given a value).

21. For microbiology (cultures, etc) reported as arbitrary concentration, LOINC system always generates two values, one (a body structure) for INHERES-IN and another (a specimen) for DIRECT-SITE.

22. For arbitrary concentration of a cross-reacting antigen, the value of TOWARDS should be the disjunction (inclusive OR) of the entities that cross-react.

23. Gene mutation analysis in the Component field is translated into a property called “gene taxon” which can take values that name various mutations.

24. For microbiology sensitivity tests measuring sensitivity to combined drug products (e.g. sulfamethoxazole/trimethoprim), the TOWARDS should be a code for the combined substance (a “portion of a mixture of sulfamethoxazole with trimethoprim”), NOT two values of TOWARDS (ie. “TOWARDS sulfamethoxazole” AND “TOWARDS trimethoprim”) – this is wrong NOR a conjunction or disjunction of the two values : “TOWARDS ( a portion of sulfamethoxazole OR a portion of trimethoprim)” – also wrong “TOWARDS (a portion of sulfamethoxazole AND a portion of trimethoprim)” – also wrong The latter really means TOWARDS null because there is no portion of sulfamethoxazole that is also a portion of trimethoprim.

6.2.3.4.4.2 Rules for converting NPU codes into observable entities

1. NCCLS antigen codes in the “proc#” field (for example, NCCLS/f89 is the allergen code for mustard) defines the value of TOWARDS.

2. IRP (international reference plasma) defines the TECHNIQUE by which the assay is calibrated.

3. System spec. = fPt (fasting patient) is translated to PRECONDITION = fasting.

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4. Comp spec = administered with proc# = p.o. translates to INHERES-IN = dose and PRECONDITION = administered p.o.

5. For fractions and ratios, system becomes the value of RELATIVE TO. Total amount is assumed in the RELATIVE TO slot. A substance is used as the value of RELATIVE TO, rather than a property of the substance. (creatinine, not creatinine concentration).

6. When the RELATIVE TO value is located or inherent in something other than the value of INHERES-IN, then that other site/location/substance is represented as the value of REL-TO-INHERES-IN.

7. proc# = T23:30 means PRECONDITION = 11:30 PM specimen

8. fungal DNA is defined as DNA that part-of fungus

9. coagulum retraction: define as retracted coagulum vs full coagulum. Possibly could be hidden in a TECHNIQUE value without losing any interoperability.

6.2.3.4.5 Observables and results for microbiology tests

- When Microbiology Laboratory results are encoded it is important for users to be aware of the context provided by the observation (i.e. the test performed) and therefore the implied meaning for the result value (i.e. the organism). For example, the combination of LOINC for the lab test and SNOMED CT for the organism, provides a unique and specific meaning when encoding Microbiological Laboratory tests and organism result values.

  - LOINC provides microbiology reporting codes with attributes including the property through the use of “PRID” (presence or identity) and the scale through the use of “NOM” which indicates a nominal or categorical response that does not have a natural ordering as the result value (typically the name of organism).

  - Use of Organism concepts in combination with such LOINC codes will imply that a specific organism is seen, detected, identified, isolated, or present.

  **Note:** An organism code on its own (in the absence of a lab test and in some cases assisted by an information model) cannot imply anything about it being present or absent, or anything other than the definition of that organism in SNOMED CT. Its detection or presence can only be implied when it is paired with other information that may come from the information model including the LOINC observation.

  - Reports should use “X or Y (finding)” concepts when the use case indicates that it is assumed to be a single isolate and the lab is unable (for any reason) to differentiate for the result instance. E.g. “Human coxsackie virus or human echovirus (finding)”;

  - The use of terms of the form “X species”, such as “Salmonella species”, is routine in laboratory reporting, but in the context of the Linnaean organism hierarchy there is no difference between “Salmonella species” and simply “Salmonella” the genus. In the context of a laboratory report, the term “Salmonella species” sometimes is intended to convey additional information beyond the place of the identified organism in the Linnaean hierarchy, but the intended connotation may vary from lab to lab and from organism to organism. Since the organism code represents a class of organisms, it cannot also represent what was or was not done, or what will be done, to identify the organism. It also cannot properly represent other information about the result. If there is additional information that needs to be communicated, it should be in a separate statement or comment (e.g. “further species identification pending” or “sent to reference laboratory for further identification”, or “further identification to be done if clinically indicated”).

6.2.3.5 Context terminological Model

6.2.3.5.1 Situation with explicit context

Concepts in the | Situation with explicit context | hierarchy (given the appropriate record structure) can be used in a clinical record to represent:

- Conditions and procedures that have not yet occurred (e.g. | Endoscopy arranged (situation) |);
- Conditions and procedures that refer to someone other than the patient (e.g. | Family history: Diabetes mellitus (situation) |, | Discussed with next of kin (situation) |);
- Conditions and procedures that have occurred at some time prior to the time of the current entry in the record (e.g. | History of - aortic aneurysm (situation) |, | History of - splenectomy (situation) |).

In each of these examples, clinical context is specified. The second example, in which someone other than the patient is the focus of the concept, could be represented in an application or record structure by
combining a header term Family history with the value Diabetes. The specific context (in this case, family history) would be represented using the record structure. In this case, the precoordinated context-dependent concept | Family history: Diabetes mellitus (situation) | would not be used because the information model has already captured the family history aspect of the diabetes.

Concepts in the | Procedure | and | Clinical finding | hierarchy have a default context of the following:

- The procedure has actually occurred (versus being planned or cancelled) or the finding is actually present (versus being ruled out, or considered);
- The procedure or finding being recorded refers to the patient of record (versus, for example, a family member);
- The procedure or finding is occurring now or at a specified time (versus some time in the past).

In addition to using the record structure to represent context, there is sometimes a need to override these defaults and specify a particular context using the formal logic of the terminology. For that reason, SNOMED CT has developed a context model to allow users and/or implementers to specify context using the terminology, without depending on a particular record structure. The | Situation with explicit context | hierarchy and various attributes assigned to concepts in this hierarchy accomplish this.

Examples of Situation with explicit context concepts:

- | Family history: Myocardial infarction (situation) | ;
- | No family history of stroke (situation) | ;
- | Nasal discharge present (situation) | ;
- | Suspected epilepsy (situation) | .

Note: See also Attributes used to define Situation with Explicit Context concepts.

6.2.3.5.2 The meaning of "situation with explicit context"

SNOMED CT contains some Concepts that include “context” information and some that are regarded as “context-free”. The precise meaning of “context” in this discussion is rather elusive and it is almost certainly coloured by perspective. The following definition seeks to encapsulate the essential aspect of “context” in relation to SNOMED CT.

A concept includes “context” information if the name of the concept explicitly represents information that might otherwise be represented by another less “context-rich” concept in a particular structural placement within a record. Context elements typically alter the meaning in such a way that the resulting concept is no longer a subtype of the original concept.

Context can be expressed in at least three ways:

1. precoordinated expressions can represent context embedded within the meaning of an existing concept name.
2. postcoordinated expressions can embed context by combining codes to make a composed expression.
3. Context can be represented by a code or expression placed in an electronic record field which has predefined meaning.

Examples:

- The precoordinated expression 266897007 | Family history of myocardial infarction | might be put directly in a blank field in a record. A family history of myocardial infarction is not a subtype of | myocardial infarction |, so “family history” modifies context.
- Alternatively, family history of a myocardial infarction can be represented using the postcoordinated expression 281666001 | family history of disorder | : 246090004 | associated finding | = 22298006 | myocardial infarction |.

From one perspective there is arguably no such thing as a “context-free” concept since the freedom from context is itself a frame of context around a concept!

The potential for a Concept to undergo axis modification as a result of surrounding contextual information in patient records has been explored in various initiatives. These include the standards work of CEN, HL7 and a variety of initiatives in UK, Europe, Australia and the US. Different labels have been given to similar aspects of this issue “major modifiers” (ENV13606) or “primary status terms” (NHS Clinical Terms Project), “modifiers” (GEHR, GP2GP).
• "Hip replacement planned" might be represented as |prosthetic arthroplasty of the hip| within a section of record on "Planned actions". A planned hip replacement is not a kind of hip replacement, so the “Planned actions” record section modifies context.

• The |precoordinated expression| 54355006 |intracranial injury, without skull fracture| might be placed directly in the record, or might instead be represented as 127296001 |intracranial injury| in a record that also contains a negative finding “Absent”+|fracture of skull|. The record might make the Relationship between these two entries explicit or it might depend on their temporal Relationship. A disorder "without skull fracture" is not a subtype of skull fracture, so “without” modifies context.

• |Normal blood pressure| might be placed in a field labelled as "Goal". A goal of a normal blood pressure is not a kind of |normal blood pressure|, so “goal” modifies context.

**SNOMED CT** requires a terminological model to consistently cope with both *precoordinated* and *postcoordinated* contextual constructs. Designers and implementers of systems need guidance to identify which fields within their record structure will critically affect the meaning of the placed code. They require open strategies of dealing with such instances to preserve meaning if retrieved or transferred and allow detection of equivalence to constructs derived from alternative approaches.

**6.2.3.5.2.1 Variable meanings according to context of use**

The implicit contextual assumptions noted above are by no means universal. The same Concepts can be used in many different ways with quite different intended meanings. The following list identifies some of the different contexts of use.

• A |disorder| Concept might also be recorded to represent:
  • A possible diagnosis or part of a differential diagnosis
  • A diagnosis applied to a family member or some other contact person
  • A diagnosis explicitly excluded
  • A diagnosis now known to be incorrect but which was the basis for a particular course of treatment.
  • An absent feature of a related disorder.
  • A diagnosis that the patient believes or fears they have.

• A |procedure| Concept might also be recorded to represent:
  • A requested, recommended or planned procedure
  • A procedure for which consent has been given or withheld
  • A procedure that is contra-indicated
  • A procedure that has been cancelled or postponed
  • A procedure for which follow up is now being arranged.
  • A procedure which is the cause of a complication.

• A symptom Concept might also record
  • Confirmed absence of that symptom
  • A symptom deduced and reported by a third party as a witness of a clinical event.
  • Inability or failure to obtain information about a symptom
  • A symptom which the patient is advised to respond to in a particular manner.

• A finding Concept might also record
  • Absence of that finding
  • Inability or failure to check for that finding
  • A finding which if present is to trigger a particular change in clinical management.
  • A finding stated which is the goal or target of a treatment.

• A therapeutic product Concept might also record
  • An allergy or other contraindication to that product.
  • An assertion than that product caused a particular side effect.
    • Various types of therapeutic activity involving the product
    • Advice to a patient to take a treatment (i.e. over the counter products)
    • Clinical authorisation of one or more prescriptions
• The issuing of prescription for a course of treatment
• Supply (dispensing) of a specified quantity of that product
• Administration of a single dose of a product
• Changes treatment dosage
• Discontinuation of a course of treatment with that product
• A recommendation from a specialist to treat a patient with a particular product if certain circumstances apply.

6.2.3.5.2.2 Critical Record Instances

When a user places a concept from SNOMED CT within an electronic record the action of chronicling transforms the concept from being a theoretical representation of a clinical notion to an actual instance within the owner (patient) of the record. For example if the concept Meningococcal meningitis is entered into a patient’s electronic record it usually indicates that the patient has had an instance of this disease. Similarly the entry of Cholecystectomy would imply that the patient has undergone this procedure.

Each record system is structured differently and might use different field definitions that could subtly affect the exact meaning of the entered concept. The placement of a concept into a record field can be identified to affect the meaning in one of two ways:

• Affect the quality of the meaning but not the instance

  The placement of Angina in fields labelled “Current problems”, “Past medical history” or “History of” all indicate that an instance of angina has occurred in the patient but assign different timescales and possible significance to the event (and the concept assumes a status compatible with its default value status).

• Critically affect the meaning and the instance

  In this case the placement in the record field critically affects meaning. For example the placement of Parkinsons disease within a field designed for recording “Family history” or Coronary angioplasty within a field allocated for “Planned procedure” does not indicate an instance of the concept in the owner (patient) of the record. The adopted status is not compatible with the default value status. In these circumstances the designer of the system will need to identify the appropriate context values from a authoritative list to be linked to concepts placed within the fields to substitute their default values.

The context model uses attributes which reference values which critically affect the meaning of a concept when applied (and change the axis of class to which they relate).

6.2.3.5.2.3 Systematic (weak) defaults

Procedures and clinical findings have systematic un-stated defaults. These are weak defaults in that they are the default value if the concept appears in a record with no explicit context. For example, if knee pain appears in a record with no context, we assume it is present in the patient, and current. If gastrectomy appears with no context, we assume it is done to the patient, at the current time. Observable entities behave like clinical findings when given a numerical value or qualitative interpretation but they behave like procedures otherwise.

6.2.3.5.2.4 Axis modifiers

An axis modifier is an attribute-value pair that does not result in a subtype of the modified concept when it is understood as carrying the systematic default meaning. For example, family history applied to diabetes makes | subject relationship context |=| family member |, and this is not a subtype of | subject relationship context |=| subject of record | (the default) for a disease (e.g. diabetes), so family history is an axis modifier and critically affects the meaning within the patient record. In contrast, specifying the precise family member with a given family history does not axis modify a representation of the combined concept family history diabetes e.g. ischemic heart disease | subject relationship context |=| father |
6.2.3.5.3 Attributes used to define Situation with Explicit Context concepts

Table 173: Approved Situation attributes summary

<table>
<thead>
<tr>
<th>Defining Attribute</th>
<th>Allowable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSOCIATED FINDING</td>
<td>Clinical finding</td>
</tr>
<tr>
<td>FINDING CONTEXT</td>
<td>Finding context value</td>
</tr>
<tr>
<td>ASSOCIATED PROCEDURE</td>
<td>Procedure</td>
</tr>
<tr>
<td>PROCEDURE CONTEXT</td>
<td>Context values for actions</td>
</tr>
<tr>
<td>TEMPORAL CONTEXT</td>
<td>Temporal context value</td>
</tr>
<tr>
<td>SUBJECT RELATIONSHIP CONTEXT</td>
<td>Person</td>
</tr>
</tbody>
</table>

**Note:**
Meaning of Allowable Values (Range) notations:

- (<<) this code and descendants,
- (<) descendants only,
- (<=) descendants only (stated) except for supercategory groupers,
- (==) this code only,
- (< Q) descendants only when in a qualifying Relationship,
- (< Q only) descendants only, and only allowed in a qualifying Relationship.

**Note:** See also Situation with explicit context.

6.2.3.5.3.1 Context

The meaning conveyed by a SNOMED CT code in a medical record is affected by the context in which it is recorded. For instance, the code for "breast cancer" might be used to indicate a family history of breast cancer, a past history of breast cancer, or a current diagnosis of breast cancer. Each of these three meanings differs in regard to the context in which breast cancer is being described. Family history of breast cancer refers to breast cancer occurring in a family member of a patient. Past history of breast cancer indicates that the breast cancer occurred in the patient, at some time in the past, and it is not necessarily present now. Current diagnosis of breast cancer indicates that the breast cancer is present now, and in this patient. These differences are important for data retrieval, because it would be incorrect when searching for patients with breast cancer to retrieve those who merely have a family history of breast cancer.

6.2.3.5.3.2 Default Context

When a SNOMED CT code appears in a record without any explicitly stated context, that code is considered to have a default context. The default is "soft" in that it can be over-ridden by information carried in the structure of the record or its information model.
The default context for a clinical finding code implies that the finding has actually occurred (vs. being absent), that it applies to the subject of the record (the patient), and that it is occurring currently or occurred at a past time that is given by a date - time record linked to the code.

The default context for a procedure code implies that the procedure was completed, that it was performed on the subject of the record (the patient), and that it was done at the present time or in the past at a time that is given by a date - time record linked to the code.

6.2.3.5.3.3 Axis Modifiers

The six attributes used to define situation codes permit explicit (rather than default) representation of various contexts. These attributes can change the meaning of a clinical finding or procedure code in a way that changes the hierarchy (or "axis") of the code from | Clinical finding | or | Procedure | to | Situation with explicit context |. The resulting modified meaning is not a subtype of the original meaning of the code, and therefore the axis-modifying attributes are not used to qualify the code, but instead are used to qualify a "situation" code.

For instance, if | Fine needle biopsy (procedure) | is given the non-context modifying attribute | Procedure site - Direct | and a value of | Urinary bladder structure (body structure) |, the resulting concept | Fine needle biopsy of urinary bladder (procedure) | is still a subtype of the original concept | Fine needle biopsy (procedure) |. However, the concept | Urine protein test not done (situation) | uses the context-modifying attribute | PROCEDURE CONTEXT | and a value of | Not done (qualifier value) |, and the resulting concept is not a subtype of | Urine protein test (procedure) |. Its axis (hierarchy) has been modified.

6.2.3.5.3.4 Overview of context attributes

Of the six attributes applied to concepts in the | Situation with explicit context | hierarchy, two are used only in representing the context in which a | Clinical finding | is recorded, ( | ASSOCIATED FINDING | and | FINDING CONTEXT |); two are used only in representing the context in which a | Procedure | is recorded ( | ASSOCIATED PROCEDURE | and | PROCEDURE CONTEXT |); and two attributes are used in representing the context of both | Procedure | and | Clinical finding | ( | SUBJECT RELATIONSHIP CONTEXT | and | TEMPORAL CONTEXT |).

6.2.3.5.3.5 ASSOCIATED FINDING

This attribute links concepts in the | Situation with explicit context | hierarchy to their related | Clinical finding |. It specifies the | Clinical finding | concept whose context is being modified.

Table 174: Permissible values for ASSOCIATED FINDING

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clinical finding</td>
</tr>
<tr>
<td></td>
<td>Event</td>
</tr>
<tr>
<td></td>
<td>Observable entity</td>
</tr>
<tr>
<td></td>
<td>Link assertion</td>
</tr>
<tr>
<td></td>
<td>Procedure</td>
</tr>
<tr>
<td></td>
<td>Family history of stroke (situation)</td>
</tr>
<tr>
<td></td>
<td>•</td>
</tr>
</tbody>
</table>

Note:

When | ASSOCIATED FINDING | is used in postcoordinated expressions, its range is broader than when used in distributed content.

| ASSOCIATED FINDING | must not reference concepts that already have precoordinated context themselves.

For example, the following definition uses | FH: Thyroid disorder | incorrectly:

| History of thyroid disease in father | |
| • | SUBJECT RELATIONSHIP CONTEXT | | father |
| • | ASSOCIATED FINDING | | FH: Thyroid disorder |

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The following is the correct definition:
<table>
<thead>
<tr>
<th>History of thyroid disease in father</th>
</tr>
</thead>
<tbody>
<tr>
<td>• SUBJECT RELATIONSHIP CONTEXT</td>
</tr>
<tr>
<td>• ASSOCIATED FINDING</td>
</tr>
</tbody>
</table>

6.2.3.5.3.6 FINDING CONTEXT

The FINDING CONTEXT attribute is used to represent a situation in which a *Clinical finding* is known or unknown, and if known, whether it is present, absent, or uncertain (possible); and also to express the meaning that the finding is not actual but instead an anticipated or possible future finding.

Table 175: Permissible values for FINDING CONTEXT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding context value</td>
<td>410514004 (&lt;)&lt; Q)</td>
</tr>
<tr>
<td></td>
<td>ASSOCIATED FINDING</td>
</tr>
<tr>
<td></td>
<td>FINDING CONTEXT</td>
</tr>
</tbody>
</table>

6.2.3.5.3.7 ASSOCIATED PROCEDURE

This attribute links concepts in the | Situation with explicit context | hierarchy to concepts in the | Procedure | hierarchy for which there is additional specified context.

Table 176: Permissible values for ASSOCIATED PROCEDURE

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure</td>
<td>71388002 (&lt;)&lt; Q)</td>
</tr>
<tr>
<td>Observable entity</td>
<td>363787002 (&lt; Q only)</td>
</tr>
</tbody>
</table>

6.2.3.5.3.8 PROCEDURE CONTEXT

This attribute indicates the degree of completion, or *status*, of a | Procedure |, as well as its various possible future states prior to its being initiated or completed.

Table 177: Permissible values for PROCEDURE CONTEXT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context values for actions</td>
<td>288532009 (&lt;)&lt; Q)</td>
</tr>
<tr>
<td></td>
<td>ASSOCIATED PROCEDURE</td>
</tr>
<tr>
<td></td>
<td>PROCEDURE CONTEXT</td>
</tr>
</tbody>
</table>

6.2.3.5.3.9 TEMPORAL CONTEXT

This attribute indicates the *time* of occurrence of the situation, indicating whether the procedure or finding that it represents is actual and therefore occurred in the present, in the past, or at a specified *time*; or that it is planned or expected, that is, temporally located in the future. The most general value is simply | Current or past (actual) |, meaning that the *concept* was actual (not planned or expected), but not specifying anything further about its *time*. The word "specified" in the | TEMPORAL CONTEXT | values means that there is a date - *time* stamp associated with the code in the record, that gives a date and/or *time*, as a point and/or interval, that applies to the *concept*. 
### Table 178: Permissible values for TEMPORAL CONTEXT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal context value</td>
<td>History of - hematuria (situation)</td>
</tr>
<tr>
<td>410510008 (&lt;=)(&lt; Q)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 6.2.3.5.3.10 SUBJECT RELATIONSHIP CONTEXT

This attribute is used to specify the subject of the Clinical finding or Procedure being recorded, in relation to the subject of the record. In the example below, the subject of the record is the patient and the subject who smokes is the patient's father.

### Table 179: Permissible values for SUBJECT Relationship CONTEXT

<table>
<thead>
<tr>
<th>Concept Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>Father smokes (situation)</td>
</tr>
<tr>
<td>125676002 (&lt;=)(&lt; Q)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 6.2.3.5.4 Contextualised Observable Entities

Observable entities, when they have not been given a value, behave like procedures with respect to the concept model for context. Observable entities, when they have been given a value, behave like Clinical Findings with respect to the concept model for context.

#### 6.2.3.5.5 Rules for Situation Definition and Modelling

Once a concept code has context-shifted and become context-dependent, it is nonsense to use that concept code in an expression that once again shifts context. In other words, when one context attribute is given an axis modifying value, it forces the other context attributes to be fixed. For example, the model for Family history of diabetes is:

\[\text{IS A} \text{ situation-with-explicit-context}\]

- [408732007 | subject relationship context [family member]
- [AssociatedFinding] diabetes
- [TemporalContext] current-or-past
- [FindingContext] known-present

Even though the family part of the concept results in an explicit axis shift of the [408732007 | subject relationship context ] only, we impose a rule that requires [TemporalContext] and [FindingContext] to be given their default values, rather than being left unspecified.

The concept that would be expressed as No family history of diabetes allows negation of Family history of diabetes by switching the value of [FindingContext], and changing [TemporalContext] to all times past:

\[\text{IS A} \text{ Situation-with-explicit-context}\]

- [408732007 | subject relationship context [Family member]
- [AssociatedFinding] diabetes
- [TemporalContext] all times past
- [FindingContext] known-absent

What is NOT a legitimate expression is:

- [FindingContext] known-absent
• [AssociatedFinding] Family history of diabetes

6.2.3.5.5.1 Role grouping

In context-dependent expressions, [AssociatedFinding] or [AssociatedProcedure] are role grouped with the other context attributes that have a value. Also, [AssociatedFinding] and [AssociatedProcedure] must not themselves reference concepts that have embedded context.

The following examples illustrate the rule that, once a concept code has context-shifted and become context-dependent, it is nonsense to use that concept in an expression that once again shifts context. To negate a concept code with [FindingContext] KnownPresent, the value of [FindingContext] becomes KnownAbsent.

For example:

Family history of asthma

IS A situation-with-explicit-context

• [AssociatedFinding] asthma
• [SubjectRelContext] family member
• [FindingContext] known-present
• [TemporalContext] current-or-specified

No family history of asthma

IS A situation-with-explicit-context

• [AssociatedFinding] asthma
• [SubjectRelContext] family member
• [FindingContext] known-absent
• [TemporalContext] all-times-past

No asthma

IS A situation-with-explicit-context

• [AssociatedFinding] asthma
• [SubjectRelContext] subject-of-record
• [FindingContext] known-absent
• [TemporalContext] current-specified

6.2.3.5.5.2 Mandatory context statements

When asserting a concept within a record it should be mandatory to apply the three context attributes and an applicable value in order to guarantee accurate meaning if that concept (plus context) is subsequently transferred to another record environment.

6.2.3.5.6 Background — SNOMED CT Glossary of Context

6.2.3.5.6.1 Introduction

One problem with any discussion of context is that we use words and phrases without necessarily sharing an understanding of what they mean. To address this problem, the Context Group agreed to use the working definitions in the following sub-section.

6.2.3.5.6.2 Context

When we talk about context we are describing the effects of embedding a concept in a clinical situation.

• A concept is embedded in a clinical situation when it is used in a clinical record.

For example:

• In the abstract the concept "myocardial infarction (disorder)" (ConceptId =22298006) could be used to refer to the idea of this disorder in a general way as a pure notion. This concept has the potential to be used in many ways (e.g. as a literature reference, as one of a set of possible complications of smoking, as a link to a protocol for care of a patient admitted with chest pain, as a contraindication for a particular medication, as a disorder suffered by a particular patient, as a possible diagnosis justifying
a particular investigation, as a diagnosis excluded by an investigation, as a condition suffered by a close relative of a particular patient, etc).

- When the concept “myocardial infarction (disorder)” is used in a clinical record it takes on a specific contextualised meaning. This specific meaning might be an assertion by a particular author that on a given date patient was diagnosed as having had a “myocardial infarction”.

Embedding a concept in a clinical situation may elaborate the semantic interpretation of a concept in one of several ways. Four distinct types of elaboration are recognised for the purpose of this discussion.

- **Subtype qualification**
- **Axis modification**
- **Affirmation or Negation**
- **Combination**

### 6.2.3.5.6.3 Elaboration

We use “elaboration” to refer to any addition to or change of the meaning of a concept that may be brought about when it is embedded in a clinical situation.

### 6.2.3.5.6.4 Subtype qualification

We use “subtype qualification” to refer to an elaboration of a concept that results in a concept that is a subtype of the original unelaborated focus concept.

- **Subtype qualification refines or increases the precision of meaning of a concept.**

For example:

- The concept | Fracture of femur | can be elaborated by an indication of whether the fracture is open, whether it is the left or right femur that is fractured. A patient who has an “open fracture of the neck of the left femur” has a type of “fracture of the femur”. Therefore, refining the morphology, site and adding laterality all act as subtype qualifications.
- The concept “Asthma attack” can be elaborated by an indication of severity. A patient who has had a | severe asthma attack | has had a type of “asthma attack”. Therefore, severity acts as a subtype qualification.
- The concept “Hysterectomy” may be elaborated by specifying a priority and a particular approach. A patient who has had a “routine vaginal hysterectomy” still has had a type of “hysterectomy”. Therefore both priority and approach is a subtype qualification.

### 6.2.3.5.6.5 Axis modification

We use “axis modification” to refer to an elaboration of a concept that results in a concept that is not a subtype of the original unelaborated concept.

- **Axis modification places the elaborated concept in a different axis of the logical semantic hierarchy.**

For example:

- The concept “Myocardial infarction” can be elaborated by including it in part of a clinical record specifying “family history”. A record of a “family history of myocardial infarction” does not imply that the individual patient has had any type of “myocardial infarction”. Therefore, “family history” acts as an axis modification.
- The concept | Total hip replacement | can be elaborated by stating that this procedure is planned to be carried out at some future date. A record of | planned total hip replacement | does not imply that the patient has actually had a | total hip replacement |.

---

14 **Subtype qualification** has also been referred to in other works as “qualifiers” (ENV136060, GEHR, CTV3) and “secondary status terms” (NHS Context of Care). The adjective “subtype” expresses more clearly the distinctive property of a qualifier. This is helpful because “modify” and “qualify” are treated by many dictionaries and some ISO authorities as synonymous.

15 **Axis modification** has also been referred to in other works as “major modifiers” (ENV136060), “modifiers” (GEHR), “primary status terms” (NHS Context of Care). The Context Group view was that none of these labels were sufficiently specific to convey the intended meaning unambiguously. The adjective “axis” expresses the sense of a fundamental shift in meaning in a way that should be familiar to those who used earlier “multi-axial” releases of SNOMED.
6.2.3.5.6.6 Affirmation or Negation

A concept may be stated in the negative in a clinical situation e.g. meningism not present. This creates potential for a concept to be used represent two meanings one of which is the inverse of the other.

- According to perspective affirmation and negation may simplistically be viewed as inversion of the meaning of an unelaborated concept representing a clinical finding.
- However, the effects of negation on interpretation are profound and distinct from other elaborations and must be considered separately.

Negation, like axis modification, results in a concept that is not a subtype of the unelaborated concept. However, negation is a special case in that:

- It explicitly rules out the unelaborated concept.
  - The statement | family history of myocardial infarction | does not imply that "patient has had a myocardial infarction" is untrue. But "no headache" (if true) implies the statement | patient has headache | is untrue.
  - Furthermore, the implications of a negative statement propagate in the opposite direction from those of a positive statement.
  - If “headache” is a subtype of “pain” then | patient has headache | implies the patient has some pain. However, | patient has no headache | does not imply the patient has no pain.
  - Conversely | patient has headache | does not imply the patient has an occipital headache but "patient has no headache" implies the patient does not have an occipital headache.

6.2.3.5.6.7 Uncertainty

A concept may be stated to be possible in a clinical situation. Statements that explicitly indicate uncertainty can be considered in two possible ways:

- As points on the arc between affirmation and negation.
- As a kind of axis modification.

6.2.3.5.6.8 Combination

Two or more concepts may be embedded in a clinical situation in a way that links them together.

- Linkages may include:
  - Simple combination of concepts;
  - Combination of a concept that is stated as present and another stated to be absent;
  - An explicit typed Relationship between concepts.

6.2.3.6 Body structure

| Body structure | concepts include normal as well as abnormal anatomical structures. Normal anatomical structures can be used to specify the body site involved by a disease or procedure.

**Examples of Body structure concepts:**

- Mitral valve structure (body structure)
- Uterine structure (body structure)

Morphologic alterations from normal body structures are represented in the sub-hierarchy | Body structure, altered from its original anatomical structure (morphologic abnormality) |

**Examples of Body Structure, altered from its original anatomical structure concepts:**

- Adenosarcoma (morphologic abnormality)
- Polyp (morphologic abnormality)

**Note:** See also Attributes used to define Body structure concepts.
6.2.3.6.1 Anatomical structures

The top level of the anatomy hierarchy appears as those concepts under physical anatomical entity which is located under the body structure hierarchy as shown in the following list:

- **SNOMED CT concept**
  - Body structure
    - Anatomical or acquired body structure
      - Acquired body structure
      - Anatomical structure
    - Anatomical organisational pattern
    - Anatomical site notations for tumour staging (this needs to be moved elsewhere)
    - Morphologically altered structure
    - Physical anatomical entity
      - Group of anatomical entities
      - Anatomical spatial entity
      - Anatomical structure (the reified S part of the SEP triple)
        - Entire anatomical structure (the E part of the SEP triple)
        - [multiple other immediate subtypes of anatomical structure]

**6.2.3.6.1.1 General Principles Underlying the SNOMED CT Model**

**6.2.3.6.1.1.1 The Structure-Entire-Part (SEP) model**

SNOMED CT uses a **structure-entire-part** triple, known as the SEP triple, to represent anatomical structures.

The following *Relationships* provided a way for the anatomy in CTV3 to be mapped to RT:

![Diagram](image)

The SNOMED CT anatomy hierarchy differentiates classes of **entire** anatomical entities from classes of "parts of" entire anatomical entities.

**Entire concept**: Denotes a class that is instantiated by entire anatomical entities of some kind: entire heart is instantiated by all individual hearts.
Entity **Part concept**: Denotes a class that is instantiated by all anatomical entities that are a proper part of some entity of a given kind: heart part is instantiated by all entities that are a proper part of some heart, e.g., my mitral valve, your right ventricle, Joe's sinus node. Heart part is NOT instantiated by any heart.

Entity **Structure concept**: Subsumes both the related Entire and Part concepts. Consequently, it denotes a class which is instantiated by anything that instantiates either the Entire or the Part. For instance, Heart structure is instantiated by my heart, my mitral valve, your heart, your right ventricle, Joe's sinus node, Joe's heart, etc.

The code named Liver structure in CTV3 is equivalent to Liver structure in the diagram above. Both the CTV3 code for Liver structure and the SNOMED RT code for Liver are interpreted to mean Some or all of the liver. **Site** attributes (| PROCEDURE SITE |, | FINDING SITE |) will usually take the value liver structure rather than | entire liver |, since typically the site of a "liver disorder" or "procedure on the liver" is not necessarily the entire liver.

6.2.3.6.1.1.1 Purpose of the Structure concept

Adding the Entity Structure codes is a convenience to assist with the logic-based aggregation of references to the entity or its parts. The implication of this view is that the E of the SEP triple is the code that should be regarded as the one that represents the real anatomical entity that is named. For example, the code for entire liver is the one that should correspond to the code for liver in the Foundational Model of Anatomy (FMA). The *subtype hierarchy* for entire liver fits much better with the FMA hierarchies, and indeed it might be possible to completely reconcile SNOMEDs non-Structure components with FMA anatomy.

A database has been developed that categorises codes in the physical anatomical entity hierarchy according to their status as S structure, P Part or E Entire, and provides the corresponding S and P code for each E code. This should provide some value to implementers. It can help with navigation, coordination with formal ontologies of anatomy, and selection of codes for postcoordination.

6.2.3.6.1.1.2 Naming conventions

"S" concepts are usually named | x structure (body structure) | or | structure of x (body structure) |.

"E" concepts are usually named | entire x (body structure) | or | x entire (body structure) |.

"P" concepts are usually named | x part (body structure) | or | part of x (body structure) |.

6.2.3.6.1.1.2.1 Plurals

Outside the anatomy section of SNOMED, plurals were primarily used as headers, while the individual concept names were singular. In the anatomy section, we have taken plurals to represent meaningful differences from their singular counterparts.

For example, cranial nerves in the FSN would mean a group of cranial nerves, while cranial nerve would not imply more than one.

6.2.3.6.1.1.3 Conventions for merging concepts from SNOMED RT and Clinical Terms v.3

Where there were two concepts with the same name, the SNOMED RT code was to become the "S" code, and the CTV3 code was to become the "E" code. There are still instances of unrecognised pairing of the RT-CTV3 "S"-"E" pair, where neither codes FSN has been changed according to the naming conventions in this document. When these unmatched pairs are identified, it is our practise to change the FSNs accordingly, and to make the "E" code have a *subtype* (is-a) link to the "S" code.

6.2.3.6.1.1.4 "S" concepts without a corresponding "E" concept

Some "S" codes do not currently have a corresponding "E" code *subtype*, and there was no policy that required that such "E" codes be created during the merger of SNOMED RT and CTV3. However, it is likely that such a policy will be enforced in the future.

6.2.3.6.1.1.5 S Structure codes can subsume entities other than E or P

The SEP triple may give the impression that all S codes have exactly two children, one E and one P, with all of the remaining *descendants* placed under P. Again, in the past this degree of modelling consistency was not always followed. Some codes were purposely made *subtypes* of the S that are not strictly part of the corresponding E. For example, perirenal tissue is a kidney structure but not a part of the kidney. It is used to define perirenal abscess so that it is subsumed by renal abscess. While a perirenal...
abscess is not strictly within the substance of the kidney, it is still considered a kind of renal abscess, and the S anatomy hierarchy is used to support this inference.

This policy has introduced undesirable variation and arbitrariness into the terminology, and future revisions will seek to eliminate these variations. Where a code is needed for a site that is really meant to extend to entities that are not part of any kidney, this will be made clear in the name, e.g. Structure of kidney and perirenal tissue.

6.2.3.6.1.1.1.6 Countable vs non-countable “E” entities

The “E” code needs to be interpreted with care when the “x” name refers to entities that do not have the property of identity, meaning that they are not countable wholes, or could be interpreted as non-countable. In this circumstance, the interpretation of E means some portion of the thing being named. Examples include tissue and types of tissue such as fascia, muscle, tendon, bone tissue, connective tissue, skin, mucosa/mucous membrane, nerve tissue, etc. Muscle, tendon, bone and skin can identify a type of tissue as well as an individual organ of that type. Bone tissue has no identity, but a particular bone does have identity.

To use skin as the archetypal example, the E code for skin of finger means a portion of the skin of a finger, so all of its subtypes must also be portions of skin. The S code for skin of finger then has a subtype P which would mean proper part of a portion of skin of finger. This admits subtypes that are not kinds of skin, but may be parts of skin, including layers. For example, epidermis of finger (meaning a portion of epidermis of finger) could be a proper part of a portion of skin of finger.

6.2.3.6.1.1.1.6.1 Tissues, layers, membranes: portions

We regard the E code for x tissue, x layer to have the meaning portion of x tissue, and therefore regional subdivisions of tissue types are direct subtypes. For example, transitional epithelium of urinary tract, as an E kind of code, should be a supertype of transitional epithelium of urinary bladder. The reason is that (portion of) transitional epithelium of urinary bladder is a kind of (portion of) transitional epithelium of urinary tract.

We also deal with layers the same way. For example, we regard serosal layer and serosa tissue as meaning the same thing, since all serosal tissue is configured as a layer, and it can’t be a serosa without being a layer; and their E codes mean portion of serosal layer or portion of serosal tissue.

As another example, layer of retina would be a supertype of nerve fibre layer of retina, and also a supertype of retinal epithelium, where retinal epithelium represents a portion of the epithelium of the retina and is therefore a kind of (portion of) a layer.

6.2.3.6.1.1.1.7 Groups

The identity/countability issue extends to a problem differentiating groups of entities from one of the group. For example, consider x= “lymph node group”, y=lymph node. In this case, the group should be linked to the member via an appropriate Relationship (not yet in SNOMED), such as has-member. In those cases where y is always necessarily a member of group x, it could be linked via a member-of Relationship (also not yet in SNOMED).

6.2.3.6.1.1.1.8 What does part-of mean?

There are several possible ways of interpreting part-of. In SNOMED, a part-of B means that in normal anatomy, the entire structure A is structurally included in B. Another way of saying it is that A is part-of B if there is no part of A that is not also part of B. For example, the humerus is not part-of the shoulder region, because the distal humerus is part of the humerus, and the distal humerus is not part of the shoulder region.

We do not use part-of for non-anatomical meanings, such as grouping tests together in batteries, nor do we use it to indicate Relationships that are not strict anatomical inclusion.

Some recent work has begun to differentiate between part-of that is reflexive (that is, an entity is in some sense a part-of itself, much the same that a set can be viewed as a subset of itself), versus proper-part-of, where an entity cannot be a proper-part-of itself. For now, we regard part-of Relationships as implying strict partonomy.

There is sometimes confusion about parthood as opposed to location. For example, an embryo is not part of a mother’s body, but a kidney is. The anatomy section is composed mainly of canonical parts; but a few abnormal parts are included to permit them to be used as the location of tumours or injuries. For example, a Meckels diverticulum is a body structure that is part of the small intestine, and it is also a
morphological abnormality. Likewise some stomas and other post-surgical structures are considered part of the body. A transplanted liver or kidney would be considered part of the body, as a post-surgical structure, even though the transplanted organ is not genetically identical. Likewise transplanted bone marrow is part of the body.

Non-living implants and devices, and foreign bodies, on the other hand, are considered to be located in the body but not part of the body.

6.2.3.6.1.1.1.9 Can the SNOMED CT relationships table be used to construct a part-of hierarchy?

The currently distributed part-of Relationships need to be much more extensively modelled and quality assured. At present they are not "defining", that is, their CharacteristicType in the relationship file is "additional", and therefore they do not affect the classifier behaviour. A substantial amount of effort has gone into a draft of the updated part-of Relationships; these will require review and approval before incorporation into the release. This will eventually result in the SEP triplet structures and part-of relations being strictly paralleled. It is a matter of time to implement and quality assure the changes.

6.2.3.6.1.1.10 Why are part-of relationships not "defining"?

The SEP structure, combined with the inference mechanism that is used with SNOMED CT, allows us to take advantage of anatomical Relationships to infer subsumption (is-a) Relationships between disorders, procedures, and other entities without reference to part-of Relationships. The SEP structure also permits us to fully define anatomical structures without reference to part-of Relationships (making them "necessarily true" but not among the "necessary and sufficient" conditions). For example, the | Structure of left hand | can be fully defined as a | hand structure | with | laterality |=left. This definition is sufficient. Converting the part-of Relationships to have CharacteristicStatus = defining will require significant changes to the current model.

6.2.3.6.1.1.11 Entities with mass versus purely spatial massless entities

Points, lines, and surfaces can be considered to be massless. The FMA calls these immaterial. It is important to differentiate the codes/names for these entities from those that are intended to represent entities that have mass. At present, the concepts under anatomical spatial entity represent massless entities. Massless entities are not represented using the SEP model. It is conceivable that users may want to reference parts of a surface, and to enable this we would need to apply the SEP model to anatomical spatial entities, or else adopt defining part-of Relationships.

6.2.3.6.1.1.2 Attributes used to define Body structure concepts

Just one attribute is used in Anatomy, namely, | Laterality | .

Note: See also Body structure.

6.2.3.6.1.1.2.1 LATERALITY

This attribute provides information on whether a body structure is left, right, bilateral or unilateral. It is applied only to bilaterally symmetrical body structures which exist on opposite sides of the body.

Table 180: Permissible values for LATERALITY

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side 182353008 (&lt;=)</td>
<td>Left kidney structure (body structure)</td>
</tr>
<tr>
<td></td>
<td>•</td>
</tr>
</tbody>
</table>

Note:
Permissible values for this attribute include the descendants of the concept listed, except for super category grouper concepts.
6.2.3.6.1.2 Specific policies related to anatomy

6.2.3.6.1.2.1 Body parts – Body regions

We have made some use of the FMA definition of “body part” and “body part subdivision”. The various joint regions listed below are classified as body part subdivisions, since that is what is intended by the various diseases and procedures that use these codes in their definitions. They are not body parts because they are defined not by a set of bones but rather by a particular joint and its surrounding structures. However, our interpretation of the word region is according to common usage and is intended as a three-dimensional structure, not the FMA two-dimensional definition of body region. In other words, these regions are not simply virtual surface regions, but include the three dimensional structures as well. They include the overlying skin, the subcutaneous tissues, the bones, muscles, tendons, fascia, vessels and other included organs and tissues in the region.

6.2.3.6.1.2.1.1 Surface regions

Several codes contain the phrase surface region. These could be interpreted as massless (immaterial) mathematical surfaces, but a clinical terminology would have no direct use for such meanings in clinical records. They could be interpreted as having mass (not immaterial), but the depth then is a matter for fiat declaration. Should it be just skin deep, or should it include deeper layers of the surface? If only skin deep, the meaning of these codes would overlap with codes for skin regions. If deeper, the meaning would possibly be the same as the generic structure codes.

In the absence of a clear use case for these codes, it is also interesting to see what use has been made of them in the logic-based definitions. Many of those that are used (as of 20060131) also have corresponding codes that do not contain the surface region designation, and this creates inconsistency in modelling, with some using x structure and others using x surface region. Buttock and shoulder are the two most egregious examples.

Therefore, for the 20060731 release, all surface region codes will be retired as ambiguous, with MAYBE-A references to their corresponding codes that are clearly not immaterial, including x structure, entire x, and skin of x. Where the x structure codes do not currently exist, they will be created, without the surface region phrase, which is ambiguous.

6.2.3.6.1.2.1.2 Joints – Joint regions

In many diseases and procedures, reference is made to areas of the body that may ambiguously imply either a joint or a region surrounding the joint. The main words that may ambiguously refer to either a joint or a region are:

- Ankle = Ankle joint structure [70258002] Ankle region structure [344001]
- Knee = Knee joint structure [49076000] Knee region structure [72696002]
- Hip = Hip joint structure [24136001] Hip region structure [29836001]
- Wrist = Wrist joint structure [74670003] Wrist region structure [8205005]
- Elbow = Elbow joint structure [16953009] Elbow region structure [127949000]
- Shoulder = Shoulder joint structure [85537004] Shoulder region structure [16982005]

Bone structure of shoulder girdle [272691005]: This code is used to define procedures and diseases affecting some bone tissue of the shoulder region. It is therefore not a kind of bone (organ), but it is a kind of bone structure, and is part of the shoulder region. Any part of the proximal humerus, scapula or clavicle is included.

Interarticular joint structure (synonym: "tarsal joint") [27949001]: This is a structure that is part of a group of joints forming articulations between the seven bones of the tarsus. The talocalcaneonavicular joint [27162001] is the articulation between the talus and the other bones of the tarsus, and is thus assumed to be what is meant by the rarely-used term "talotarsal joint". The subtalar joint [127863007] is the same as the talocalcaneal joint. Dislocations of the subtalar joint will ordinarily also involve the talonavicular joint [127864001]. The subtalar and talonavicular joints taken together constitute the talocalcaneonavicular joint.

6.2.3.6.1.2.1.3 Orbital region

| Orbital region structure | is a synonym for | eye region structure | which subsumes bony orbit, eye and ocular adnexa.
6.2.3.6.1.2.1.4 Limbs

The meanings of the words "arm" and "leg" are prone to misinterpretation and ambiguity. In general English usage, "arm" can mean the upper limb, but it can also mean the upper arm, i.e. the part of the upper arm between the shoulder and elbow. "Leg" can mean the lower limb, but it can also mean the lower leg, i.e. the part of the lower limb between the knee and ankle.

In all hierarchies, including disorders, procedures, anatomy, and others, the fully specified name should not rely on the word "arm" or the word "leg" alone to designate the anatomy being referenced.

External sources, such as the WHO Classifications, may have conventions for interpreting the meaning of phrases that contain the words "arm" and "leg", and those conventions should be followed to determine the meanings of ICD rubrics in mapping and other actions that rely on the meanings from those external sources. The ICD conventions are sometimes at variance with common clinical parlance and will not necessarily match exactly the terms in SNOMED CT. For example, the rubric "injury of leg" in ICD may mean "injury of lower leg" in SNOMED CT.

6.2.3.6.1.2.1.5 Shoulder region – Upper limb; Hip region – Lower limb

The shoulder region is part of the upper extremity, and the hip region is part of the lower limb. This follows the general pattern used in the International Classification of Diseases 9th Edition (ICD-9) where one finds upper limb including shoulder and lower limb including hip. It also follows the rigorous ontological views of the FMA, in which the upper limb consists of the free upper limb and the pectoral girdle (of which the shoulder region is part), and the lower limb consists of the free lower limb and pelvic girdle (of which the hip region is part). A code has been added for free lower limb, i.e. the lower limb not including the pelvic girdle. One could in the future be added for free upper limb, i.e. upper limb not including pectoral girdle.

6.2.3.6.1.2.1.6 Axilla – Upper limb – Trunk

The axilla is bounded by the upper limb laterally and the thorax medially; therefore from one perspective it is not strictly part of either the upper limb or the trunk. The alternative view is that it is both. Axilla structure is currently defined in SNOMED as being both an upper limb structure and a thoracic structure.

6.2.3.6.1.2.1.7 Lower limb – Lower Leg – Leg – Foot

The lower limb (syn: lower extremity) includes the foot, but the lower leg (syn: leg) does not. Stedman's definition of lower leg is "The segment of the inferior limb between the knee and the ankle". "Leg" is used in ICD classifications to mean "lower leg". Common usage in English makes "leg" a synonym of "lower extremity". In order to avoid confusion, FSN's should always specify "lower leg" or "lower extremity". When an FSN (for a procedure or clinical finding code) has only the word "leg" with no other wording in the FSN that would allow determination of which meaning is intended, the code is ambiguous and should be retired.

6.2.3.6.1.2.1.8 Mouth region – Oral region of face – Teeth – Tongue – Larynx

6.2.3.6.1.2.1.8.1 Meaning of the word "mouth"

There are several different meanings of the word mouth. These include mouth region, oral region of face, and rima oris.

6.2.3.6.1.2.1.8.1.1 Mouth region

The mouth region includes structures surrounding the oral cavity as well as structures of the oral region of the face. Most disorders that have a finding-site of mouth should use mouth region.

6.2.3.6.1.2.1.8.1.2 Oral region of face (labial part of mouth)

The oral region of the face includes the skin and subcutaneous tissues of the lips and perioral region, plus the orbicularis oris muscle, and any vessels and nerves in these structures.

6.2.3.6.1.2.1.8.1.3 Rima oris

The rim of the opening bounded by the lips is called the rima oris.
6.2.3.6.1.2.1.8.2 Teeth – Maxilla – Mandible

Even though teeth are supported by the maxillary or mandibular bone, they are not "part-of" the maxilla [70925003] or mandible [91609006]. Teeth are part of upper jaw [4335006] and lower jaw [48077000].

6.2.3.6.1.2.1.8.3 Root of tongue

Prior versions had different codes for the base and root of the tongue. We found no reproducible distinction, and have retired base of tongue [7283002] as a duplicate of root of tongue. The four regional parts of the tongue are the ventrum, dorsum, root and body. The root of the tongue is the posterior third, the dorsal surface of which forms the anterior wall of the oropharynx. The root of the tongue rests on the floor of the mouth. The nerves and vessels that supply the intrinsic muscles of the tongue traverse the root of the tongue.

6.2.3.6.1.2.1.8.4 Inferior surface of tongue

Even though SNOMED 2 and SNOMED 3 had separate codes for inferior surface of tongue and ventral surface of tongue, we regard them as synonyms. There is no ventral surface of the posterior third of the tongue, so the ventral surface of the anterior two thirds is the same as the ventral surface, which is the inferior surface.

6.2.3.6.1.2.1.8.5 Larynx – Inlet of larynx – Interarytenoid fold – Hypopharyngeal aspect of interarytenoid fold

The interarytenoid fold forms part of the inlet of the larynx. The fold has two surfaces, one forming part of the wall of the supraglottic larynx, the other forming part of the wall of the hypopharynx (the "food tube" behind the larynx, leading to the oesophagus). Is the "hypopharyngeal aspect of the interarytenoid fold" a part of the hypopharynx, the larynx, or both? A tumour of this site should be categorised as a tumour of the hypopharynx, and not as a tumour of the larynx, but the interarytenoid fold [105585004] is considered part of the larynx. Given these two facts, we do not give a part-of Relationship between the hypopharyngeal aspect of the interarytenoid fold and the interarytenoid fold. This emphasises the fact that we determine how to model anatomical entities based on the way that model causes disorders and procedures to be organised, not based on a simple reading of the term names.

6.2.3.6.1.2.1.9 Abdominal regions

The named regions of the abdomen are by tradition divided horizontally by the transpyloric plane and the interspinous plane, and vertically by the midclavicular plane. The lateral regions are therefore bounded above by a plane that is inferior to the ribs. In contrast, the flank is the lateral region of the abdomen bounded above by the ribs. Thus some parts of the hypochondriac regions, which are superior to the transpyloric plane but inferior to the ribs, would be considered also part of the flank. The hypogastric region is also sometimes called the pubic region.

6.2.3.6.1.2.2 Skin or skin-associated mucosa

This is an example of a body structure that is used to group and aggregate related terms. The term | Structure of skin and/or skin-associated mucous membrane (body structure) | intentionally employs disjunction (inclusive 'or'). Its referents include structures in the layers deeper than the surface epithelium, but exclude any non-skin-associated mucosal epithelium, such as bronchial, gastrointestinal, and genitourinary sites of squamous cell neoplasms. The "skin and/or surface epithelium" concept was created to represent the sites of these neoplasms.

Skin and/or skin-associated mucosa is intended for use in dermatology. It is not intended to subsume all mucosal structures, which are under | Mucous membrane structure (body structure) |. For the meaning of "diseases of the skin", refer to the draft of ICD-11: "Diseases of the skin incorporate conditions affecting the epidermis, its appendages (hair, hair follicle, sebaceous glands, apocrine sweat gland apparatus, eccrine sweat gland apparatus and nails) and associated mucous membranes (conjunctival, oral and genital), the dermis, the cutaneous vasculature and the subcutaneous tissue (subcutis)."

6.2.3.6.1.2.3 Skin regions – Skin of <named body part>

Since the phrase | skin of finger | can mean "some or all of the skin of finger" (if interpreted as a structure rather than an entire in the SEP model), we could use "is-a" to represent the Relationship between | skin of finger | and | skin of hand |. Thus | skin of finger | is-a | skin of hand |, is-a | Skin structure of upper extremity |, is-a "skin region". We have refrained from adding the word "region" to all of these names, since it could be confusing without a clear distinction between the entire region and some subregion.
6.2.3.6.1.2.3.1 Scalp

Formal definitions of scalp include layers beneath the skin. Therefore we make a distinction between the scalp and the skin of the scalp.

6.2.3.6.1.2.4 Organs – Organ system subdivisions

The FMA notion of body organ is also used. Organs include individual bones, joints, muscles, arteries, veins, lymph vessels, nerves, etc. Codes with a meaning that includes groups of such organs are frequently listed in SNOMED. In most cases, these have been interpreted to be entities in the subsumption hierarchy (is-a hierarchy) of the particular organ type, that is, they are kinds of organ. When we also need a concept that means the collection of organs (rather than an organ in the collection), we have created another entity (code) that is a kind of organ system subdivision. But many such collections don’t yet have such a corresponding organ system subdivision code. The default has been to interpret codes as denoting organs rather than organ system subdivisions.

Examples:

<table>
<thead>
<tr>
<th>Organ</th>
<th>Organ system subdivision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertebra (bone of vertebral column)</td>
<td>Spine (subdivision of skeletal system)</td>
</tr>
<tr>
<td>Cervical vertebra</td>
<td>Cervical spine (subdivision of spine)</td>
</tr>
<tr>
<td>Third cervical vertebra</td>
<td></td>
</tr>
<tr>
<td>Bone of skull</td>
<td>Skull (subdivision of skeletal system)</td>
</tr>
<tr>
<td>Bone of thoracic cage</td>
<td>Thoracic cage (subdivision of skeletal system)</td>
</tr>
<tr>
<td>Rib</td>
<td></td>
</tr>
<tr>
<td>Third rib</td>
<td></td>
</tr>
<tr>
<td>Right third rib</td>
<td></td>
</tr>
<tr>
<td>Quadriceps femoris muscle</td>
<td></td>
</tr>
<tr>
<td>Quadriceps femoris muscle, left</td>
<td></td>
</tr>
<tr>
<td>Vastus medialis muscle</td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.6.1.2.5 Cell, Tissue, Organ

In general, organs are made up of tissue, and tissue is made up of cells. However, a cell is not necessarily part of tissue, and tissue is not necessarily part of a named organ.

6.2.3.6.1.2.6 Body systems and tracts

Many terms are used imprecisely in clinical practise and in medical publications to refer to body systems or tracts, and ambiguities frequently arise with many of these terms. In particular, the terms for the gastrointestinal, alimentary, genitourinary, genital, urinary, respiratory, biliary, lymphatic, lymphoid, immune, reticuloendothelial, and haematopoietic systems of the body may have multiple interpretations.

We have (arbitrarily) made the following definitions and distinctions in order to achieve internal consistency of the terminology. We recognise that it may not be possible to get universal consensus regarding the names that should be used for each of these codes. The goal is to be consistent and clear in defining the meaning of each code, and to allow users and system designers to present the terms that best reflect these meanings in their own implementation contexts.

6.2.3.6.1.2.6.1 Urinary system – Urinary tract – Genitourinary system – Genitourinary tract

Urinary system:

The urinary system includes the organs involved in the formation and secretion of urine, including the kidney, ureters, bladder, and urethra. Urinary system includes the prostatic urethra (since it is a male urinary outflow structure) but excludes other parts of the prostate (and the prostate as a whole) and also excludes the seminal vesicles (see lower urinary tract). Unless clearly specified otherwise, urinary tract and urinary system are considered synonyms, and terms that include the phrases are interchangeable. For example, computed tomography of urinary tract is the same as computed tomography of urinary system. Broad categories that are intended to exclude the kidney should specifically use the
term urinary tract proper (see next). Examples include operation on urinary tract proper and disease of urinary tract proper.

**Urinary tract proper:**

The urinary tract proper includes the organs involved in the secretion of urine but excludes the kidney itself; it includes the renal pelvis, ureters, bladder, and urethra. It is a fairly subtle distinction from urinary system, but may be useful for categorising disorders affecting the flow of urine (as opposed to its formation), such as urinary tract obstruction, and as the site of tubular structures lined with urothelium. Because urinary tract is ordinarily used as a synonym of urinary system, we have added the word proper to distinguish this more specific meaning (which excludes the non-collecting parts of the kidney) from the broader meaning.

**Upper urinary tract:**

The upper urinary tract is the urinary system above the junction of ureter with the bladder, and consists of the kidneys and ureters. Since upper urinary tract infections include kidney infection, the upper urinary tract must include the kidney. The FSN of this concept is kidney and/or ureter structure (body structure), and it has a synonym of upper urinary system.

**Upper urinary tract proper:**

The upper urinary tract proper is the part of the urinary tract proper above the junction of the ureter with the bladder. It consists of the renal collecting system and the ureter.

**Lower urinary tract:**

The lower urinary tract is the urinary system below the junction of the ureter with the bladder. It consists of the bladder and urethra. Lower urinary tract and lower urinary system are the same. The male and female specific components are located under male urinary outflow structure and female urinary outflow structure, respectively.

**Genitourinary system:**

The genitourinary system includes the entire urinary system as well as the genital system. We consider genitourinary tract to be synonymous with genitourinary system.

**Genital system:**

The genital system is comprised of both internal genital organs and external genitalia. Genital tract is defined only for the female: The female genital tract is comprised of ovaries, fallopian tubes, uterus, vagina and vulva.

6.2.3.6.1.2.6.2 Digestive system – Digestive tract – Alimentary tract – Gastrointestinal tract

**Digestive tract** is the same as the alimentary tract, and includes the entire passage for food through the body, including mouth, oral cavity (both vestibule of mouth and cavitas oris propria), oropharynx, oesophagus, stomach, duodenum, jejunum, ileum, colon, rectum, and anal canal.

**Digestive system:** includes the digestive tract as well as the associated organs of digestion, including tongue, teeth, salivary glands, liver, exocrine pancreas, gallbladder and biliary tract.

**Gastrointestinal tract:** There are two meanings in common usage of this term. The first would more properly be named the oesophago-gastrointestinal tract, since the oesophagus is ordinarily included. Endoscopists frequently adopt this meaning, even though it is contrary to some dictionary definitions, which exclude the oesophagus. Including the oesophagus also does not follow a strict lexical interpretation.

**Upper gastrointestinal tract:** By convention in describing upper GI bleeding and upper GI radiographic and endoscopic procedures, this includes the oesophagus, stomach and duodenum. It is part of the gastrointestinal tract that includes the oesophagus, but obviously not part of the more restricted stomach-intestine entity.

**Lower gastrointestinal tract:** By common convention in describing lower GI bleeding, lower GI radiographic and endoscopic procedures, and lower GI output from ileostomies and colostomies, this includes the jejunum, ileum, cecum, colon, rectum and anal canal. The ligament of Treitz may be used as the dividing line between upper and lower GI tract (and the dividing line between duodenum and jejunum). See J Vasc Interv Radiol 9:747 for an example that shows inclusion of the jejunum and below as part of the lower GI tract. Also, since the upper GI tract is said to end at the duodenum-jejunum boundary, and there is no code meaning middle GI tract, the jejunum can be inferred to be in the lower GI tract.
6.2.3.6.1.2.6.3 Biliary tract – Liver

**Biliary tract**: includes the gallbladder and the intrahepatic and extrahepatic bile ducts, and the common bile duct. It does not include the liver itself. We use “biliary system” as a synonym for biliary tract. (Another code might be created to mean an entity that includes the entire liver with the biliary tract, but we do not at present perceive a need for it).

6.2.3.6.1.2.6.4 Lymphoid – Lymphatic – Immune – Mononuclear phagocytic – haematologic – haematopoietic – dendritic cell systems

**Lymphatic system** ([Lymphatic system structure ID: 89890002]): is conceptually the set of structures through which lymph flows. It includes the lymph nodes (lymph node structure ID: 59441001) and lymphatics (structure of lymphatic vessel ID: 83555006). It supports the categorisation of findings, disorders and procedures that relate to the flow of lymph.

**Lymphoid system** ([Lymphoid system structure ID: 122490001]): is conceptually the set of structures made up of aggregates of lymphoid cells. It includes lymphoid aggregates of the intestine, marrow, liver, and other locations, and the lymph nodes, spleen, and thymus, and tonsils & adeonoids. It excludes the lymph vessels. It supports categorisation of lymphomas.

**Immune system** ([Immune system structure ID: 116003000]): includes all of the lymphoid system, as well as the mononuclear phagocytic system. There are also essential components of the immune system that are cellular and sub-cellular and are involved in cellular and humoral immunity.

**Mononuclear phagocytic system** ([Mononuclear phagocytic system structure ID: 127908000]): a collection of true macrophages, distributed widely in the body (splenic sinusoids, liver Kupffer cells, pulmonary alveolar macrophages, osteoclasts, macrophages in serous membranes, and microgliocytes). It is part of the immune system.

**Dendritic cell system** ([Dendritic cell system structure ID: 127909008]): a collection of antigen-presenting cells, including epidermal Langerhans cells, dendritic reticulum cells, and interdigitating cells. Class I histiocytes (Langerhans cell histiocytosis) are disorders of the dendritic cell system.

**Reticuloendothelial system** ([Reticuloendothelial system structure ID: 6013009]): an outdated term, includes the true macrophages (the mononuclear phagocytic system) and also additional endothelial cells that line lymphoid sinuosids and haematopoietic tissues.

**Haematologic system** ([haematological system structure ID: 414387006]): includes the bone marrow, the lymphoid system, the haematopoietic system, and the terminal cells of all lineages of the haematopoietic system (red cells, white cells, platelets, histiocytes, plasma cells, etc). This means that disorders of the haematologic system do not necessarily include disorders of the haemostatic system, even though bleeding and thrombosis are usually categorised as haematologic.

**Haematopoietic system** ([haematopoietic system structure ID: 57171008]): includes the structures and cells responsible for erythropoiesis, granulocytopenesis, monocytopenesis, thrombocytopenesis, and lymphopenesis. Haematopoietic should be differentiated from haematologic, since the terminal cells of each lineage (the erythrocyte, segmented neutrophil, monocyte, histiocyte, platelet, mature T- and B-cells, plasma cells, etc.). are no longer strictly haematopoietic.

6.2.3.6.1.2.6.5 Circulatory system – systemic, central, peripheral, cerebrovascular, intracranial, extracranial

6.2.3.6.1.2.6.5.1 Systemic vs pulmonary circulation

The systemic circulatory system is the combined arterial and venous circulation that begins where blood leaves the left ventricle and ends where blood enters the right atrium. It excludes the coronary circulation.

The pulmonary circulation is the combined arterial and venous circulation that begins where blood leaves the right ventricle and ends where blood enters the left atrium.

The heart chambers are also considered part of the circulatory system.

6.2.3.6.1.2.6.5.2 Central vs peripheral vs cerebrovascular system

The term central vascular is not in common use. In fact, the term does not appear in **SNOMED** at all. However, the term peripheral vascular is very common, and therefore it requires a definition that (by default) sets the boundary between central and peripheral vascular systems.
The simplest definition of peripheral vascular system is that it is the vascular system that is not central; and then the central vascular system includes the pulmonary circulation, coronary circulation, cerebrovascular system, thoracic aorta, superior vena cava, inferior vena cava, and mediastinal blood vessels.

Peripheral vascular disease is often distinguished from cerebrovascular disease and coronary artery disease. These are the three major categories of diseases caused by problems in vascular circulation in general, and atherosclerosis in particular. As a result of this clinical distinction, the cerebrovascular system is excluded from the peripheral vascular system.

Cerebrovascular is commonly defined in two ways: as either the blood vessels in the brain, or the blood vessels that supply the brain (including those within the brain). Because cerebrovascular disease includes extra-cranial occlusions of the vertebral and carotid arteries, we define the cerebrovascular system as those vessels involved in the supply and drainage of blood to the brain. Convention does, however, tend to exclude the innominate artery - which gives rise to the left common carotid and the arch of the aorta which gives rise to the right common carotid. Convention also excludes the subclavian arteries which give rise to the vertebral arteries.

6.2.3.6.1.2.6.5.3 Intracranial vs extracranial vascular system

Some vascular trees are located wholly within the cranial cavity, but some (internal carotid; vertebral) cross the boundary between extra- and intra-cranial. Intracranial segments of such vascular trees must be individually identified as such, and the entire vascular tree must not be categorised as either extra- or intra-cranial. See tree-structured organs below. These are regional parts of venous or arterial tree organs.

6.2.3.6.1.2.6.6 Blood – Cardiovascular system – Haematopoietic system

The blood is not necessarily part of the cardiovascular system, nor is it necessarily part of the haematopoietic system. If it were, then leukemia would be a cardiovascular disorder, and septicemia would be a haematopoietic disorder. Since these inferences violate our clinical expectations, we make the underlying model of anatomical Relationships support the kind of Relationships that are correct and expected. Thus blood is a body fluid, not strictly part of either the haematopoietic or cardiovascular systems.

6.2.3.6.1.2.6.7 Endocrine system

The endocrine system structurally is composed of the endocrine pancreas, pineal body, paraganglia, paraaortic bodies, parathyroid glands, endocrine ovary, endocrine testis, adrenal glands, pituitary gland, thyroid gland, the juxtaglomerular apparatus, and some diffuse neuroendocrine structures.

Certain parts of the thymus have been shown to be capable of producing endocrine hormones, but the thymus itself is not categorised as part of the endocrine system.

6.2.3.6.1.2.6.8 Haematopoietic system – Blood – Spleen – Lymph nodes – Thymus

Haematopoietic is used to mean the not-as-yet-mature cellular elements that eventually form the cellular components of blood. The blood itself cannot be strictly part of the haematopoietic system, since this would cause all components of blood to be part of the haematopoietic system (including components like albumin, clearly not "haematopoietic"). Leukocytes, red cells and platelets are the result of haematopoiesis, but they are not blood-forming themselves, in the strict sense we are using (otherwise leukocytosis would become a disorder of haematopoiesis, whereas it can arise simply from a demargination of white cells following stress). We have created a code named "cellular components of blood"; note that platelets are not actually cells, but are "cellular components". Likewise, for spleen, lymph nodes and thymus, we have created "haematopoietic cells of spleen" etc. to indicate that they are part of the haematopoietic system. This enables differentiation of disorders of the haematopoietic system from infectious, traumatic and other disorders, and prevents incorrect autoclassification.

6.2.3.6.1.2.6.9 Nervous system

The nervous system is divided into central and peripheral subdivisions. The central nervous system, sometimes also called the neuraxis, consists of the brain and spinal cord. The pyramidal system is a subdivision of the central nervous system; the extrapyramidal system is part of the brain. The peripheral nervous system includes all neural structures outside the central nervous system. The nervous system is also subdivided into autonomic, somatic and enteric subdivisions. The autonomic system is further divided into sympathetic and parasympathetic subdivisions. The autonomic system is not entirely a part
of the peripheral nervous system; but all autonomic nerves are peripheral (see the section on tree-structured organs and the meaning of nerve.)

6.2.3.6.1.2.6.10 Respiratory tract – Respiratory system – Upper aerodigestive tract

We have chosen to have | respiratory tract | mean the same as the Nomina Anatomica term "apparatus respiratorius", which includes the structures through which air passes from the nares to the alveoli. The oral cavity, however, is not included (even though functionally one might expect it to be). The phrase respiratory system is sometimes regarded as a synonym of | respiratory tract |, but we have given them separate meanings. Respiratory system does not, however, mean the global respiratory system that might include the CNS components of breathing. Pleura are part of the lower respiratory system, but not a part of the lower respiratory tract (see below).

**Upper aerodigestive tract** is a phrase that may have several meanings. The SNOMED code for "upper aerodigestive tract" has adopted the meaning defined by Muir and Weiland in "Upper aerodigestive tract cancers", Cancer 1995 Jan 1;75(1 Suppl):147-53, which states: “Cancers of the upper aerodigestive tract constitute approximately 4% of all malignancies. These include cancer of the lip, tongue, major salivary glands, gums and adjacent oral cavity tissues, floor of the mouth, tonsils, oropharynx, nasopharynx, hypopharynx and other oral regions, nasal cavity, accessory sinuses, middle ear, and larynx.” This definition matches the tumours included in the CAP Cancer Checklist for upper aerodigestive tumours. Some publications include the oesophagus, or at least the cervical oesophagus, when referring to the upper aerodigestive tract, but we have decided to exclude oesophagus.

**Aerodigestive tract** is a phrase with more variation in meaning than "upper aerodigestive tract." There is currently no code for this term, because of the variable meanings, and limited reference to "aerodigestive tract" in the literature. It certainly would include the upper aerodigestive tract plus the tracheobronchial tree, lungs, and oesophagus, but the few literature citations using the term do not appear to intend it to include any of the digestive tract except the oesophagus, in spite of the strict lexical interpretation that might lead one to expect inclusion of the entire digestive tract. The lower aerodigestive tract would be the combination of the oesophagus and the lower respiratory tract. There is currently no code for this term.

**Upper respiratory tract** is that part of the respiratory tract from the larynx up, and includes the nasal cavity, paranasal sinuses, nasopharynx, oropharynx and larynx.

**Lower respiratory tract** begins below the larynx, and includes the tracheobronchial tree (from the trachea through the terminal bronchioles) as well as the lungs, including the alveolar respiratory tract or pulmonary region (which extends from the respiratory bronchioles to the alveoli).

**Lower respiratory system** includes the lower respiratory tract and the pleura.

6.2.3.6.1.2.6.11 Skeletal system – Bony skeleton/bone structure – Vertebral column

The skeletal system (systema skeletal in Nomina Anatomica) includes both bones and cartilages of the body. The bony skeleton includes just the bones. The vertebral column is part of the skeletal system, and includes the intervertebral discs (fibrocartilage). Individual vertebrae are part of the bony skeleton. The spinal region (also sometimes called the spine) includes the spine proper (same as vertebral column = vertebra and intervertebral discs) as well as the contents of the spinal canal, and also paraspinal ligaments, muscles, soft tissues, and skin.

6.2.3.6.1.2.6.12 Soft tissue

There are at least three different use cases (and therefore at least three different meanings) for the phrase soft tissue:

1. A category for tumours. So-called soft tissues give rise to similar types of neoplasms that appear to be of mesenchymal stem cell origin, generally termed the soft tissue neoplasms, and this appears to account for the inclusions and exclusions of the category. Non-neoplastic masses arising in the same tissues are included in the most recent WHO classification of soft tissue tumours. For tumours, soft tissue is defined as non-epithelial extraskeletal tissue of the body exclusive of the reticuloendothelial system, glia and supporting tissue of various mesenchymal organs. Other explicit inclusions are: fibrous tissue, fascia, ligaments, tendons, tendon sheaths, synovia, bursas, skeletal muscle, smooth muscle, fatty tissue, adipose tissue, blood vessels, lymph vessels, peripheral nerves, sympathetic and parasympathetic nerves and ganglia. Subcutaneous tissue is included. Skin is excluded. Skeletal

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cartilage is excluded, along with pleura, pericardium and peritoneum, the central nervous system, endocrine glands, and viscera.

FSN: Extraskeletal non-epithelial non-reticuloendothelial non-glial soft tissue (body structure)

2. A category for sites of non-bone disorders and injuries of the limbs, head, neck, and body wall. In this case, skeletal cartilage is included as a soft tissue. Skin and lymph nodes are not included, but otherwise all non-bone structures of the limbs are included. Subcutaneous tissue and fat are included. For the head, neck and torso, this category excludes reticuloendothelial system, central nervous system, endocrine glands, viscera and supporting tissues.

FSN: Musculoskeletal and/or neurovascular soft tissue excluding central nervous system and visceral soft tissues (body structure)

3. A category for structures identified in images. In this case, soft tissues include everything except for mineralised bone tissue and teeth.

Note: As of the 20080131 release, these three meanings have not been incorporated into the terminology, and therefore concepts using the phrase soft tissue require significant changes.

6.2.3.6.1.2.7 Tendons – Muscles

Is a muscle an entire functional unit, including attachments to the skeletal system, or merely the contractile part of this unit? Either choice could be made; clinically we think of the muscle as the contractile part only. The FMA definition of organ implies that tendons should be considered part of their corresponding muscles, rather than organs in their own right.

We have decided to model tendon structures as subtypes of their muscle structures. Thus the Structure of achilles tendon is a triceps surae (gastrocnemius and soleus) muscle structure. This causes the classifier to make a rupture of the Achilles tendon a kind of disorder of the triceps surae (gastrocnemius and soleus) muscle. Functionally this makes sense, even though to some users it may violate the natural sense of "muscle" as contractile tissue only.

6.2.3.6.1.2.7.1 Muscle functions

When modelling muscle categories according to their functions, assume they mean the function of the "entire muscle" unless otherwise stated. This follows the general heuristic that CTV3 codes meant "entire entity" unless otherwise stated, while SNOMED codes meant "entity structure" unless otherwise stated. Most of the muscle functional groupings came from CTV3.

6.2.3.6.1.2.8 Bones – Bone Tissue

6.2.3.6.1.2.8.1 The word "bone"

In ordinary usage, the word bone conflates the meanings bone organ and bone tissue onto the single word.

6.2.3.6.1.2.8.2 Definitions

6.2.3.6.1.2.8.2.1 Bone (tissue) structure:

a quantity of regular connective tissue which consists of osteocytes and related cells, the intercellular matrix of which is ossified. (or any part thereof)

6.2.3.6.1.2.8.2.2 Bone structure:

a bone organ or any part thereof.

6.2.3.6.1.2.8.2.3 Bone organ:

an organ with cavitated organ parts, which primarily consists of compact (cortical) and cancellous bone, which surround bone marrow cavities; other parts include periosteum, endosteum, (and, according to FMA, articular cartilage.)

6.2.3.6.1.2.8.3 Non-ossified parts of bone

Bone organs are composed primarily of bone tissue, but there are some non-ossified parts.

In particular, periosteum is clearly a part of a bone organ, but is not ossified tissue. (Articular cartilage is in dispute: SNOMED doesn't currently model articular cartilage as a part of bone, although FMA does.)
6.2.3.6.1.2.8.4 Bone marrow and marrow cavity

Because bone marrow is contained within a marrow cavity, it is in one sense included within a whole bone. If you have a whole femur, you also have its bone marrow - at least in living subjects. But in another sense the marrow is not strictly part of the bone organ itself. In skeletons, the whole femur has a cavity where the marrow was, but there is no marrow. Clinical reasoning generally does not include marrow disorders under bone disorders, nor marrow procedures under bone procedures.

**Examples:**

Bone marrow disorders are not musculoskeletal disorders, but bone disorders are.

Bone marrow transplants are not considered types of bone transplant.

Osteomyelitis is not the same as osteitis.

The (empty) marrow cavity is part of the bone organ, and the marrow is contained in the marrow cavity but is not part of the bone organ. Therefore Bone marrow structure (body structure) is not a subtype of Bone structure (body structure).

All bone marrow was intended to be the E entire counterpart to the S of bone marrow structure, and so it also is not a subtype of Bone structure (body structure).

6.2.3.6.1.2.8.5 Structure of (named bone) versus Bone structure of (named bone)

To differentiate marrow, vessels, nerves and periosteum from the actual hard tissue of bones, we differentiate structure of tibia from bone structure of tibia. The bone marrow and other soft tissues of the tibia can then be categorised separately from the hard tissues. Bone marrow diseases are not considered musculoskeletal diseases, so bone marrow structures should not be placed in the bone (tissue) structure hierarchy.

6.2.3.6.1.2.8.6 Long bone – Short bone

ICD-9 and 10 do not use the standard anatomical definition of a long bone. For example, see ICD-9-CM 213.4 and 213.5, in which benign neoplasms of the "long bones" are distinguished from benign neoplasms of the "short bones," includes the bones of the hand as short bones. Anatomical definitions of long bone cite the proportional relationship between length and width (length >> width), and it is very clear that metacarpals, metatarsals, and phalanges are included in the anatomical definition of long bone. In order to accommodate these differences between anatomical definitions and the classifications, in SNOMED CT there are anatomical groupers that correspond to the ICD groupings, so that "scapula, humerus, radius or ulna" and "long bone of thigh or lower leg" can be used as the sites for grouper concepts that match various ICD definitions and groupings.

6.2.3.6.1.2.8.7 Sternum – Manubrium, Body, Xiphoid

The sternum is considered a bone organ. The manubrium, body and xiphoid are parts of the sternum classed as zones in FMA.

6.2.3.6.1.2.8.8 Nasal turbinates – Nasal conchae

We have differentiated between the bone underlying the nasal turbinates (118648008 , 122491002 , 122492009 , and 122493004) and the turbinates themselves. The turbinates themselves (6553002 , 60962000 , 65289004 and 33415007) include both bone and overlying mucous membranes and other tissues. The inferior nasal turbinate bone is a facial bone (and skull bone) in its own right. However, parts of the ethmoid bone form the middle, superior and supreme nasal conchae. This means that the bones of the middle, superior and supreme turbinates are not bone organs.

6.2.3.6.1.2.9 Tree structured organs

Arteries, veins, nerves, and the bronchi form tree-like structures that distribute across multiple regions. Because of their extent and their interdigitation with other structures, they require some slightly different thinking and modelling. FMA deals in a very consistent way with organs that are structured as trees, which can either have a cavity or be solid. In the first category (organ with organ cavity) it has a subtype hollow tree organ. The hollow tree organs are:

- tracheobronchial tree
- biliary tree
- vascular trees
arterial trees
  • the systemic arterial tree
  • the pulmonary arterial tree

venous trees
  • the systemic venous trees (superior, inferior, and 4 cardiac trees)
  • the pulmonary venous trees (there are 4: sup L, inf L, sup R, inf R)
  • the portal venous tree

lymphatic trees (there are two: the right lymphatic duct tree, and the thoracic duct tree)

Among the solid organs, there is one category that is tree-structured. The tree-structured solid organs include:

  • neural tree organs
  • cranial nerve trees
  • spinal nerve trees
  • spinal accessory nerve tree (strictly neither a cranial nerve nor a spinal nerve per se)
  • peripheral nerve trees
  • autonomic nerve trees
  • cranial nerve-tract complex trees

Having accepted the idea of tree-structured organs, the next task is to decide what words to use in a systematic way to refer to them and their various parts.

6.2.3.6.1.2.9.1 The word "artery"

There are three potential meanings for the word "artery":

1. an arterial trunk (a single tube)
2. an arterial tree organ, and
3. an arterial trunk plus all its branches.

In modelling SNOMED meanings that refer to arteries, it is necessary to decide on a case-by-case basis which of these meanings is intended. However, some general guidance can be given that meaning (1) above is most common in clinical use.

In most cases it is easy to dispense with (2) because there are only two actual complete arterial tree organs (the systemic arterial tree arising at the aortic valve, and the pulmonary arterial tree arising at the pulmonary valve), and these are readily named as arterial tree organs, and seldom referred to by individual disorders or procedures. The remaining difficulties arise in differentiating when a trunk is intended, and when an entire tree (trunk plus branches) is intended.

If one examines clinical usage of the word "artery" for injuries and operations, the meaning is clearly a single tube. the trunk of the named artery, or trunk of the named arterial branch. A puncture wound of the femoral artery affects the femoral arterial trunk. A grafting into the popliteal artery likewise is done into the popliteal arterial trunk. Even occlusions of an artery are located by naming the trunk where the occlusion occurs; and even though the downstream distribution may be affected, collateral circulation often mitigates the effects, so it would be incorrect to interpret artery to mean the entire subtree in any of these clinical usages.

NOTE: This clinical usage is at variance with the definitions of the FMA, which defines artery as a subdivision of an arterial tree (organ) which consists of branching sets of tubes (arterial trunks) that form a tree; together with other arterial trees (organ parts), it constitutes an arterial tree (organ). It would be correct to say that FMA regards artery as an arterial tree organ part which is not just a trunk but also has branches, corresponding to item number 3 above.
6.2.3.6.1.2.9.1.1 Artery: trunk of artery vs arterial tree

6.2.3.6.1.2.9.1.1.1 Pulmonary artery – Artery of lung – Trunk of pulmonary artery

Trunk of pulmonary artery [45341000]: This is the main pulmonary artery, the "great vessel" coming off the right ventricle and splitting into right and left main pulmonary arteries. Some dictionaries make this synonymous with | pulmonary artery |.

Pulmonary artery within lung [128260003]: Any artery of the pulmonary circulation that is regionally within the lung, the boundary being defined by the hilum.

Pulmonary artery [81040000]: Any artery of the pulmonary circulation, i.e. artery(ies) conveying unoxygenated blood from the heart into the lungs, including the trunk, right and left branches of the pulmonary artery, which are within the mediastinum, and all their branches, which tend to occur at or past the hilum and are therefore regionally within the lung.

6.2.3.6.1.2.9.1.1.2 Common carotid artery – Artery of neck

The right common carotid artery usually arises from the brachiocephalic trunk behind the right sternoclavicular joint, and thus has no real thoracic portion. However, the left common carotid arises from the arch of the aorta and does have a short thoracic portion. Should the common carotid artery (not specifying laterality) be an artery of neck, i.e. an artery that is part of the neck? Strictly speaking, it is not, because of the thoracic portion of the left common carotid. At present, however, the model of anatomy includes common carotid artery as an artery of the neck. This needs to be changed.

6.2.3.6.1.2.9.2 The word “vein”

There are three potential meanings for vein:

1. a venous trunk
2. a venous tree organ, and
3. a venous trunk plus all its branches.

In modelling SNOMED meanings that refer to veins, it is necessary to decide which of these meanings is intended. It is easy to dispense with (2) because there are only eleven venous tree organs, and these are readily named as such. The remaining difficulties arise in differentiating when a trunk is intended, and when a venous tree part (trunk plus branches) is intended.

As with the clinical usage of the word "artery", clinical usage of the word "vein" generally refers to the trunk and not the entire tree.

NOTE: This clinical usage is at variance with the interpretations of vein names given in the FMA, which defines vein as a subdivision of a venous tree (organ) which consists of branching sets of tubes (venous trunks) that form a tree; together with other venous trees (organ parts), it constitutes a venous tree (organ). Thus FMA regards vein as a venous tree organ part.

6.2.3.6.1.2.9.2.1 Vein: trunk of vein vs vein as a tree structure

Because trunks of veins, not venous trees, have been used to organise the vein hierarchy, there are implications for regional classes. For example, the internal jugular vein is a vein of the neck, but of course its entire venous tree extends into the head, and the internal jugular vein venous tree is not strictly part of the neck, even though the internal jugular vein venous trunk is strictly part of the neck.

Tributaries are also modelled as direct tributaries of the trunk. A tributary of a named vein is part of the venous tree of the named vein, but not part of the venous trunk of the named vein. Some veins that are part of the venous tree, and therefore might be regarded as indirect tributaries, are not modelled as direct tributaries of the trunk of the vein. Direct tributary is the intended meaning of tributary.

6.2.3.6.1.2.9.2.2 Vein and its tributaries

All codes with the name pattern "vein x and its tributaries" have been retired, with MAYBE-A links to "structure of vein x" and "entire vein x", because there was ambiguity about the meaning of these terms.

6.2.3.6.1.2.9.2.3 Pulmonary vein vs vein of lung

Pulmonary vein great vessel: There are four pulmonary veins that enter the left atrium, two on each side; these are what is intended by the name | pulmonary vein |. The pulmonary veins are "great
vessels” (vessels that enter the heart). Common usage sometimes might result in people referring to any vein that is part of the lung as a | pulmonary vein |, but we have a separate code (see pulmonary venous structure) for this meaning.

Pulmonary venous structure [122972007]: This means any vein that drains the lung, and a synonym is vein of lung. Pulmonary veins are kinds of "vein of lung." But | Pulmonary vein | and "vein of lung" are not synonyms.

So far, there is no code for pulmonary vein within lung.

6.2.3.6.1.2.9.2.4 Retinal vein

There is no vein named retinal vein therefore vein of retina and retinal vein are the same.

6.2.3.6.1.2.9.3 The word "nerve"

The word "nerve" potentially has multiple meanings: nerve trunk, nerve organ segment (trunk plus branches), and entire neural tree organ. If we examine the FMA nerve concepts, the comment under neural tree organ identifies only two of these meanings:

The term nerve is conventionally used as a homonym for two concepts: 1. an anatomically distinct nerve trunk (without branches) that is identified in a dissection (e.g. the structure that student identifies when a pin is placed in the trunk of the vagus nerve, for instance located on the arch of the aorta); 2. a larger anatomical entity which supports a related set of functions (e.g. all anatomical components of the vagus nerve that are necessary for it to execute its functions; for instance when a student is asked which nerve is responsible for slowing the heart his answer, the vagus nerve, includes the vagal nucleus, as well as the trunk and branches of the vagus). Neural tree designates the second concept in order to distinguish it from the first which is only a part (subdivision of) the vagal neural tree.

The third meaning is found in the definition of the FMA class labelled "nerve":

Segment of neural tree organ which has as its parts a nerve trunk and its branches; together with other nerves of the same tree it constitutes a neural tree. Examples: chorda tympani, digastric branch of facial nerve, greater petrosal nerve, posterior cutaneous branch of posterior ramus of cervical nerve, superior lateral cutaneous nerve of arm.

To summarise, the FMA has defined three meanings for nerve:

1. a nerve trunk
2. the entire neural organ including nuclei, ganglia, roots, etc.
3. a nerve trunk plus all its branches (excluding nuclei, ganglia, and roots)

It can create significant confusion we recognise that nerve is commonly used as a homonym for all three meanings. The FMA assigns the third meaning as the one that they adopt for the class labelled nerve.

The trouble in this approach to resolving the problem of what "nerve" means is that when we call the first meaning "nerve trunk" and the second meaning "nerve trunk", it is difficult to decide how to refer to the third meaning.

One solution is to use the phrase "neural organ" for the second meaning, since it is not really just a tree structure (at least an above-ground tree: the ganglia aren't in the trunk or the branches); then the phrase "nerve tree" can be used for the third meaning. This would give us the trio of nerve trunk, neural organ, and nerve tree. I think these phrases have better transparency than the trio of nerve trunk, nerve tree organ and nerve.

Unlike clinical usage for arteries and veins, the clinical usage of the word "nerve" does not reliably refer to one of the three possible meanings, but instead varies much more between the different interpretations,
based on context. If one severs the facial nerve, the meaning refers to the trunk. But if one has facial nerve palsy, the meaning refers to the entire distribution of the nerve and the functions served by it.

6.2.3.6.1.2.9.3.1 Nerves – Entire nerve – Nerve and branches – Nerve tissue

There are several codes with the phrase x nerve and its branches which came from CTV3, and they are interpreted as meaning the entire nerve and its branches. Therefore, x nerve and its branches would be a duplicate of entire x nerve, when we interpret entire x nerve as being a neural tree organ. For example, entire facial nerve is a neural tree organ, and so there is no need for an additional concept called facial nerve and its branches, which would mean the same thing. An entire cranial nerve is a neural tree organ, and structure of cranial nerve is that organ or any part (or branch) thereof. Branches of the cranial and spinal nerves are segments of the neural tree organs that they branch from.

6.2.3.6.1.2.9.3.2 Nerve and its branches

We have retired all the codes named as "nerve x and its branches", with MAYBE-A links to structure of nerve x, and entire nerve x, because of the ambiguity of the terms. To specify the trunk of a nerve requires a specific term.

6.2.3.6.1.2.9.4 Eye structures

The meanings of "subchoroidal space" and "suprachoroidal space" are the same, and refer to a potential space between the choroid and sclera. The term "lamina subchoroidea of choroid" is from SNOMED 2 and had code T-XX320. But this layer is the same as the layer termed the "lamina suprachoroidea". According to Trans Am Ophthalmol Soc. 1993; 91:545-652, "Most of the earlier reports described expulsive hemorrhage starting as a subchoroidal hemorrhage that became large and expelled intraocular contents. The more recent reports have used the term "suprachoroidal hemorrhage. " Both "subchoroidal" and "suprachoroidal" refer to the same potential anatomic space between the choroid and the sclera. In the recent literature, the terms "expulsive hemorrhage" and "subchoroidal hemorrhage" are being replaced by "massive suprachoroidal hemorrhage."

6.2.3.6.1.2.10 Cerebrum – Telencephalon – Supratentorial brain

Cerebrum may refer to the supratentorial brain, which is everything except the midbrain, medulla,pons, and cerebellum. In this interpretation, the telencephalon and diencephalon are in the cerebrum. On the other hand, cerebrum may refer only to the parts derived embryologically from the telencephalon, which are the cerebral hemispheres and the intercerebral commissure (corpus callosum and anterior commissure).

Supratentorial brain is a phrase sometimes used for categorising tumours (ICD-9 codes 191.0-5 or 191.8-9), and for designating the location of swelling that can result in herniation. The telencephalon and diencephalon (including thalamus, geniculate bodies, pineal body, habenulae, and hypothalamus) are definitely supratentorial. Strictly speaking, the upper part of the midbrain (mesencephalon) also is supratentorial. However, the broad categories of ICD codes listed above would exclude any midbrain tumours from the list of supratentorial tumours, so we follow that pattern and exclude all midbrain structures from the supratentorial brain.

6.2.3.6.1.2.11 Regional lymph nodes of the lung

We have retained codes representing the nodes in traditional anatomy (lymph nodes categorised as: pulmonary, bronchopulmonary, tracheobronchial, tracheal, and oesophageal) along with codes representing node groups used for clinical staging of lung cancer (lymph nodes categorised into 14 stations). Professional societies concerned with the clinical staging of lung cancer have developed at least three different nomenclatures for "stations" of lung-related lymph nodes. The ATS (Americal Thoracic Society) map, published in 1983, is given in Am Rev Respir Dis 1983; 127:659-669. A revised system adopted by the American Joint Committee on Cancer (AJCC) and the International Union against Cancer (UICC) in 1997 is given in Chest 1997; 111:1718-1723. Even though the numbering of the stations is very similar, the inter-Relationships between the various node groups are complex, particularly in stations 4 and 10, near the carina and hilar regions. For example, we believe that AJCC Station 10, named "hilar

17 A neural tree organ is defined in FMA as a nonparenchymatous organ which has as its parts an aggregate of neurons (nuclei or ganglia) and their axons which are grouped into fasciculi by connective tissue to form elongated, cable-like structures that are arranged into a tree. The cranial nerves and spinal nerves are considered to be neural tree organs.

18 A nerve according to FMA is defined as a segment of a neural tree organ which has as its parts a nerve trunk and its branches; together with other nerves of the same tree it constitutes a neural tree.
lymph node", is a synonym for "bronchial lymph node" and "bronchopulmonary lymph node"; however, ATS Station 10R, named "right tracheobronchial lymph node" is not a subtype of "tracheobronchial lymph node" because its definition includes nodes covered by both "lower paratracheal lymph node" (AJCC Station 4) and by "hilar lymph node" (AJCC Station 10). We use "tracheobronchial lymph node" as a supertype of both inferior tracheobronchial (subcarinal) and superior tracheobronchial (a subset of lower paratracheal).

6.2.3.6.1.2.12 Prostate lobes

The "posterior lobe" of the prostate is described in newborns but does not persist into the adult. The three prostate lobes [113295002] are the left and right lateral lobes and the variable middle lobe.

6.2.3.6.1.2.13 Abdominal cavity – Pelvic cavity

The term "abdominal cavity" has two meanings, one including the pelvic cavity, the other excluding it. Abdominal cavity structure is used as inclusive of both. Abdominal cavity proper is used as exclusive of the pelvic cavity.

6.2.3.6.1.2.14 Ear – external ear – pinna/auricle

The ear includes external, middle and inner ear. The external ear has two main parts, the auricle (also called the pinna) and the external auditory canal. The external auditory canal is sometimes also called the external auditory meatus. External auditory meatus is not just the external opening of the canal, but rather is a synonym for the canal extending to the ear drum ( tympanic membrane). The internal auditory canal is not part of the ear. It is an opening in the temporal bone, and is primarily a nerve conduit that runs roughly parallel to the external auditory canal.

6.2.3.6.1.2.15 Cardiac valves, normal and malformed

A number of concepts have been added to the anatomy hierarchy to support the representation of congenital cardiac malformations. This content was developed in cooperation with IPCCC (International Pediatric and Congenital Cardiac Code).

The following pairs of cardiac valve terms do not represent the same thing, and are siblings not superior or sub-type in relation to each other:

- Atrioventricular valve (body structure) vs. Atrioventricular (non-mitral, non-tricuspid) valve structure (body structure)
- Mitral valve structure (body structure) vs. Left (non-mitral) atrioventricular valve structure (body structure)
- Tricuspid valve structure (body structure) vs. Right (non-tricuspid) atrioventricular valve structure (body structure)

Atrioventricular (non-mitral, non-tricuspid) valves represent body structures which were anatomically abnormal from the beginning of their development. They are not called mitral/tricuspid valve although they perform the same function as their normal counterpart would. They are also represented using the term "not morphologically mitral/tricuspid valve". For example, 459176007 | Abscess of right atrioventricular (not morphologically tricuspid) valve (disorder) | represents an abscess of the right atrioventricular valve that has been developed abnormally from the beginning vs. 431189009 | Abscess of tricuspid valve (disorder) | which represents an abscess on a normally developed tricuspid valve. For a normally developed mitral/tricuspid valve, the term "left/right atrioventricular valve" can be used interchangeably. They are true synonyms. However, they cannot be used for abnormally developed valves, i.e. left atrioventricular (non-mitral)/right atrioventricular (non-tricuspid) valves.

6.2.3.6.2 Morphologic Abnormalities

The morphologic abnormality hierarchy is found two levels below the body structure hierarchy, with siblings apoptosis and tissue repair:

- **SNOMED CT concept**
  - body structure
    - morphologically altered structure
      - morphologically abnormal structure
      - apoptosis
      - tissue repair
The codes in the morphologic abnormality hierarchy represent classes of which the instances are all kinds of abnormal body structure.

### 6.2.3.6.2.1 Morphologic abnormalities vs. Findings

Codes from the morphologic abnormality hierarchy should not be used in place of codes from the clinical findings hierarchy, even though they appear to refer to similar clinical situations.

For example, *mass (morphologic abnormality)* [4147007 | Mass |] is not a finding, but *mass of body structure (finding)* [300848003 | Mass of body structure |] is a finding. Morphologies are used as the values of the defining attributes of findings and procedures. Findings are used to represent the combination of a morphology in a location. For example, *cyst of scalp* [300923002 | Cyst of scalp |] represents cystic type of morphology that is in the location scalp.

Many morphologies have names that could be (mis)-interpreted as implying a process rather than a structure. For example, inflammation might mean the structural-morphologic features of inflammation, such as inflammatory cell infiltrates; or it might mean the process that results in those structural changes. Within the morphologic abnormality hierarchy, the structural interpretation is intended, and the process interpretation is not.

### 6.2.3.6.2.2 Morphology Hierarchy General Structure

The hierarchy immediately under morphologically abnormal structure is given below, with bold font marking the broad categories that correspond to SNOMED 3 morphology sections (see text below):

- abnormal cell
- abnormal cellular component of blood
- abnormal shape
- absence
- **cellular or subcellular abnormality**
  - collagen shrinkage
  - cutaneous patch
  - cutaneous plaque
- damage
  - necrosis
  - **traumatic abnormality**
- **degenerative abnormality**
- depressed structure
- **developmental anomaly**
- effect of surgery
- eruption
- exfoliative lesion
- extracellular alteration
- fibrosis or repair abnormality
- fusion
- **growth alteration**
  - proliferation
    - proliferative mass
      - neoplasm and/or hamartoma
        - neoplasm
  
- hernial opening
- heterotopia
- honeycomb appearance
- **inflammatory morphology**
- macule
- mass
- mast cell abnormality
- **mechanical abnormality**
- minimal lesion
- narrowing
- papule
- pigment alteration
- postmortem change
- pseudomembrane
- pseudotumor
- pseudotumour
- redundant tissue
- therapy-related morphologic change
- tumour-like lesion
- tumour-like lesion
- vegetation
- widening

The classical organisation of morphology in **SNOMED 3** had ten sections, including:

- Section 0: General morphologic terms [M-0]
- Section 1: Traumatic abnormalities [M-1]
- Section 2: Congenital anomalies [M-2]
- Section 3: Mechanical abnormalities [M-3]
- Section 4: Types of inflammation [M-4]
- Section 5: Degenerative abnormalities [M-5]
- Section 6: Cellular and subcellular abnormalities [M-6]
- Section 7: Growth, maturation and non-neoplastic proliferations [M-7]
- Section 8: International classification of neoplasms (ICD-O). [M-8 and M-9]
- Section 9: Specific veterinary tumours [M-A and M-B]

Although the sections in **SNOMED 3** were generally correct, a number of changes in the hierarchy were required to satisfy strict logical subtyping. For example, neoplasms are kinds of proliferation, which is a kind of growth abnormality. But fibrosis is not strictly a growth abnormality, so it is placed outside that hierarchy. Also the phrase general morphologic term names a term, not a morphologic abnormality, and this type of general catch-all phrase should be eliminated from the **SNOMED CT** hierarchies.

### 6.2.3.6.2.3 Specific policies related to morphology

#### 6.2.3.6.2.3.1 Malignant tumour morphology and ICD-O

The origins of malignant tumour morphology codes can be traced to the Systematized Nomenclature of Pathology (SNOP) which was published in 1965. Subsequently the WHO has published three revisions of the morphology of ICD-O, and all three of these have been tightly coordinated with the M-8 and M-9 sections of **SNOMED**. For tumour morphology codes, ICD-O-2 codes and names were the same as both **SNOMED 2** and **SNOMED 3**, and ICD-O-3 codes and names are the same as the corresponding concepts in **SNOMED RT** and **SNOMED CT**.

#### 6.2.3.6.2.3.1.1 Formatting variations between ICD-O morphology and SNOMED CT tumor morphology

Minor formatting variations occur with these codes. In order to distinguish morphology codes from others in **SNOMED**, the **SNOMED** identifier has always prefixed the 5-character code with an M and a dash (-). ICD-O does not routinely do this. Another minor formatting variation that may be seen in ICD-O coded data is a forward slash (/) before the final character of the code. **SNOMED** does not ever do this. As a result, the code for acidophil carcinoma, for example, might appear in any of the following forms:
### 6.2.3.6.2.3.1.2 Non-synonymous synonyms in ICD-O

ICD-O does not necessarily provide a code for each morphologic variation of a given tumor type. It distinguishes between true synonyms and related terms. **SNOMED CT** often provides a morphology concept for the related terms as a subtype, but it never assigns an M-8 or M-9 legacy **SNOMED code** to these concepts. Instead it uses R-.. format codes.

### 6.2.3.6.2.3.1.3 The use of NOS and No ICD-O Subtype

In ICD-O, a term may end with NOS, meaning not otherwise specified. This means not otherwise specified in the patient record that I am coding. But in the context of **SNOMED CT**, the originator of the code is the pathologist or other health care professional who actually generates the original record. In this context, it makes no sense to reference the record that they are coding, because they are using the terminology to represent their original meaning, not someone else's recorded meaning.

The effect of NOS on a particular phrase in ICD-O is to specialise it to mean none of the other subtypes of this. For example, adenocarcinoma NOS means an adenocarcinoma that has not been specified to be any of the other kinds of adenocarcinoma that are available for coding in ICD-O. Therefore in **SNOMED CT**, we revise the fully specified name of these concepts to be no ICD-O subtype, meaning that it is a kind of tumor morphology that does not fit any of the other subtypes of this morphology that are named in ICD-O.

### 6.2.3.6.2.3.2 Congenital anomaly

There is significant doubt about the usefulness of some of the congenital anomaly morphologies. Many disorders that involve congenital anomalies can be defined in terms of the OCCURRENCE attribute, leaving no need for a congenital version of the more general morphology concept. For example, 90293002 *congenital stenosis* (morphologic abnormality) could be removed because 415582006 *stenosis* (morphologic abnormality) can be combined with OCCURRENCE = congenital to define disorders that involve congenital stenosis.

Because they are currently in the hierarchy, these congenital morphology concepts should usually have non-congenital parents. For example, *congenital stenosis* needs to be a child of *stenosis*, in addition to being a child of *congenital anomaly*.

### 6.2.3.6.2.3.3 Degeneration vs. Degenerative Abnormality

A distinction should be made between 33359002 | Degeneration |, and 107669003 | Degenerative abnormality |. Degenerative abnormalities, the broad group of concepts, are those morphologies characterised by retrogressive pathologic structural changes. Examples of these include degeneration proper as well as lyeses, vascular scleroses, necroses and infarcts, depositions, dystrophies, pigmentations, atrophies and depletions. In other words, 107669003 *degenerative abnormality* is a grouping concept to put together this set of things that have in common the fact of retrogressive structural degeneration.

Morphologies under degeneration also show retrogressive structural changes, but they are not necessarily any of the following: atrophy, depletion, deposition, dystrophy, lysis, resorption, malacia, necrosis, obliteration, opacity, plaque, vascular sclerosis or postmortem change. This does seem to be definition by exclusion.

Necrosis is a degenerative abnormality, but not a degeneration. Necrosis can **follow** degeneration.

Atrophy is a degenerative abnormality, but only atrophic degeneration is also a degeneration.
As a general rule, we do not assume that diseases called “degenerative” necessarily have | Associated morphology |=33359002 | Degeneration | since the word “degenerative” sometimes refers to loss of function, rather than structural degeneration.

For those disorders called “degenerative” that have a specific structural degeneration, it is preferable to use a more specific value instead of the generic 33359002 | Degeneration |, or even worse, the more general 107669003 | Degenerative abnormality |.

107669003 | Degenerative abnormality | should rarely, if ever, be used as the value of associated-morphology of a particular disorder; rather, a more specific subtype should be used as the value. It might be used as the value of | Associated morphology | for a broad category of degenerative disorders where the degeneration is always and necessarily structural. It will then be inherited by all the subtypes, unless specialised by assigning a particular subtype of 33359002 | degeneration | as the value of | Associated morphology | for that disorder.

6.2.3.6.2.3.4 Abscess

Although most abscesses are infectious, there are some sterile abscesses. If a code has a meaning (based on its FSN and text definition) that does not specify whether the abscess is sterile or infectious, then the code should not be modelled as infectious. In these general cases, the code’s logic definition uses the attribute | Associated morphology | with the value | abscess morphology | [44132006 | Abscess morphology |].

6.2.3.6.2.3.5 Fracture

Although most fractures are traumatic, there are some pathological fractures. In the vast majority of cases, fractures are traumatic.

6.2.3.7 Pharmaceuticals and biologic products

6.2.3.7.1 Pharmaceutical/biologic product

The | Pharmaceutical / biologic product | hierarchy is separate from the | Substance | hierarchy. This hierarchy was introduced as a top-level hierarchy in order to clearly distinguish drug products (products) from their chemical constituents (substances). It contains concepts that represent the multiple levels of granularity required to support a variety of uses cases such as computerised provider order entry (CPOE), e-prescribing, decision support and formulary management. The levels of drug products represented in the International Release include Virtual Medicinal Product (VMP), Virtual Therapeutic Moiety (VTM), and Product Category. Additionally, US and UK drug extensions have been developed, which represent Actual Medicinal Products (AMPs).

Note: See also Attributes used to define Pharmaceutical/Biologic Product concepts.

6.2.3.7.2 Attributes used to define Pharmaceutical/Biologic Product concepts

Table 181: Approved Pharmaceutical/Biologic Product attributes summary

<table>
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<tr>
<th>Defining Attribute</th>
<th>Allowable Values</th>
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<tbody>
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<td></td>
<td>HAS ACTIVE INGREDIENT</td>
</tr>
<tr>
<td></td>
<td>HAS DOSE FORM</td>
</tr>
</tbody>
</table>

Note: Permissible values for these attributes include the concepts listed and their descendants.

Note: See also Pharmaceutical/biologic product.

6.2.3.7.2.1 HAS ACTIVE INGREDIENT

This attribute indicates the active ingredient of a drug product, linking the | Pharmaceutical / biologic product | hierarchy to the | Substance | hierarchy.
Table 182: Permissible values for HAS ACTIVE INGREDIENT

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>105590001 (&lt;&lt;)</td>
</tr>
<tr>
<td>HAS ACTIVE INGREDIENT</td>
<td>Naproxen 500mg tablet (product)</td>
</tr>
<tr>
<td>HAS ACTIVE INGREDIENT (substance)</td>
<td></td>
</tr>
</tbody>
</table>

6.2.3.7.2.2 HAS DOSE FORM

This attribute specifies the dose form of a product.

Table 183: Permissible values for HAS DOSE FORM

<table>
<thead>
<tr>
<th>Attribute Values</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of drug preparation</td>
<td>105904009 (&lt;&lt;)</td>
</tr>
<tr>
<td>HAS DOSE FORM</td>
<td>Digoxin 0.1mg capsule (product)</td>
</tr>
<tr>
<td>HAS DOSE FORM</td>
<td>Oral capsule (qualifier value)</td>
</tr>
</tbody>
</table>

6.2.3.7.3 Pharmaceutical/Biologic Product Hierarchy

The following diagram depicts the current structure of the pharmaceutical/biologic product hierarchy.
In response to a need for improvements to the drug product hierarchy in order to meet user requirements, a revised model has been developed. This model is now a Draft IHTSDO Standard. The content of SNOMED CT has not yet been revised to conform to the draft model, however.

### 6.2.3.7.4.1 Concept Classes in Revised Draft Standard International Pharmacy Model

A Medicinal Entity (ME) is the abstract representation of the set of active ingredient(s) (devoid of strength and form), which when formulated as a medicinal product, is intended for use in the treatment of a patient. I.e. For any one Medicinal Entity, one or more NPMP concepts must exist, reflecting actual products that are or have been available in one or more IHTSDO member nations. A Relationship may exist between two medicinal entities to support the Relationships between Medicinal Entities that are “moieties” and Medicinal Entities that represent the “moieties with their modifiers” (such as base and salt).

- A Medicinal Entity is created for a moiety and for the precise ingredient(s) (moiety and modifier) where the active ingredient differs from the active moiety.
- A Medicinal Entity defines a group of products as represented by a set of one or more NPMPs, which contain substances with the same combination of active moieties.
- Medicinal Entities concepts will have a Relationship to all of their active ingredients, using one or more “has intended active ingredient” Relationship(s).
Examples of Medicinal Entities *Fully Specified Name* (FSN) and *Preferred Term* (PT) [1] include:

<table>
<thead>
<tr>
<th>Type of product</th>
<th>ME Fully Specified Name</th>
<th>ME Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Ingredient- moiety</td>
<td>amoxicillin (product)</td>
<td>amoxicillin</td>
</tr>
<tr>
<td>Single Ingredient – Moiety with modifier</td>
<td>haloperidol decanoate (product)</td>
<td>haloperidol decanoate</td>
</tr>
<tr>
<td>Multi-Ingredient – Moiety</td>
<td>codeine + paracetamol (product)</td>
<td>codeine + paracetamol</td>
</tr>
<tr>
<td>Multi-Ingredient – “Moiety” and Moiety with modifier</td>
<td>codeine phosphate + paracetamol (product)</td>
<td>codeine phosphate + paracetamol</td>
</tr>
</tbody>
</table>

**Points to note**

- Medicinal Entity can be a moiety, or a moiety plus modifier where the modifier is required to identify therapeutically relevant modifications or modifications that are the basis of strength substance (BoSS) in one or more IHTSDO member nations. In instances where a moiety plus modifier is required for BoSS considerations, it should be for the member nation to identify the requirement on a case by case basis. This means that the BoSS will always be the same concept as the active ingredient of the immediate ME parent.

- Therapeutic combinations of separate chemical entities/moieties e.g. “paracetamol and codeine” will be modelled as a single Medicinal Entity.

- Recursion is supported to allow the representation of base and base specialisation. This recursion is unrestricted however active review, approval and communication of instances where more than one layer of recursion must be a routine quality assurance activity.

- Pro-drugs will be modelled showing the pro-drug as the ingredient.

[1] RF2 contains no Description type value “Preferred Term”, only types of “Fully specified name” and “Synonym”, where the latter may be refined either to a “Preferred term” or to a “Synonym” within a language reference set. As a result of this change from RF1 to RF2, the preference for particular Descriptions in a language or dialect will be represented using a reference set.

6.2.3.7.4.1.2 Non Proprietary Medicinal Preparation (NPMP)

*A Non Proprietary Medicinal Preparation (NPMP) is an abstract concept representing the properties of one or more clinically equivalent proprietary product units of use (from (existing or past) National extensions).*

A NPMP is the abstract representation of the set of active ingredient(s) and their strength(s) and Dose form

Where strength is a ratio (concentration) example 500 mg per unit dose for discrete dosage forms or 50 mg/mL for continuous represented at a single unit level e.g. per mL or per g

A new NPMP will be created for each different strength of a licenced medicinal product. If an existing product has a change of ingredient, such that it does not conform to the ingredients of the original NPMP, then a new NPMP will be created for the new product.

**Please note** that all Non Proprietary Medicinal Preparation concepts will inherit Relationships to all of their active ingredients, as identified by the ‘has active ingredient’ Relationship from their parent ME concept.

Examples of *Non Proprietary Medicinal Preparation* Fully Specified Name and Preferred Term include:

<table>
<thead>
<tr>
<th>Type of Product</th>
<th>Fully Specified Name</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single ingredient product (moiety)</td>
<td>amoxicillin 500 mg capsule (product)</td>
<td>amoxicillin 500 mg capsule</td>
</tr>
</tbody>
</table>
### Type of Product | Fully Specified Name | Preferred Term
---|---|---
Single ingredient product (moiety) | diclofenac 46.54 mg tablet (product) | diclofenac 46.54 mg tablet
Single ingredient product (moiety with modifier) | diclofenac sodium 50 mg tablet (product) | diclofenac sodium 50 mg tablet
Multi-Ingredient (moiety) | codeine 23.43 mg + paracetamol 500 mg tablet (product) | codeine 23.43 mg + paracetamol 500 mg tablet
Multi-Ingredient (moiety with modifier) | codeine phosphate 30 mg + paracetamol 500 mg tablet (product) | codeine phosphate 30 mg + paracetamol 500 mg tablet

Points to note

- **Non Proprietary Medicinal Preparation** can identify a moiety, or a moiety plus modifier where the modifier is required to identify therapeutically relevant modifications or modifications that are the basis of strength substance (BoSS) in one or more IHTSDO Member nations. In instances where it is required as the BoSS it should be for the member nation to identify the requirement on a case by case basis.
- Recursion is supported to allow the representation of base and base plus specialisation. This recursion is unrestricted however active review, approval and communication of instances where more than one layer of recursion must be a routine quality assurance activity.
- Pro-drugs will be modelled showing the pro-drug as the ingredient.
- Member nations may create an NPMP Preferred term in their own extension where an alternative Description is required. Member nations may also create Basis of Strength Relationships and associated values in their own extension to support this alternative Description.

6.2.3.7.4.2 Expression of Strength

6.2.3.7.4.2.1 Representation of numeric values

It is recognised that there is a requirement for the expression of pharmaceutical strength in SNOMED CT to allow the full definition of medicinal product concepts, however the method utilised to achieve this is not yet determined. The representation of strength using reference sets in this document is therefore illustrative based upon the current view of best practise.

6.2.3.7.4.2.2 Active ingredient and reference BoSS association

As part of the expression of strength for full definition of NPMP concepts and to support the automatic generation of FSN and PT Descriptions for NPMPs where the active ingredient differs from the BoSS there is a requirement that each 'has reference BoSS' Relationship be associated with the appropriate 'has active ingredient' Relationship. Without this it may not always be possible to automatically identify the active ingredient for which the Basis of Strength Substance is measuring the strength. This difficulty most commonly occurs when there is more than one active ingredient in the product, which share the same base (but with different modifications or level of modification). For example, ‘Sodium Citrate + Citric Acid’ (ME). If the BOSS strength (e.g. Citric Acid 66.8 mg/mL) is associated with the incorrect ‘active ingredient’, then the NPMP actually represents a different product.

To address this issue, it is proposed that ‘Relationship groups’ are used to group each ‘has reference BoSS’ Relationship together with the appropriate ‘has active ingredient’ Relationship. The exact nature of these requirements are to be addressed in a proposal to support machine processable strengths in SNOMED CT.

6.2.3.7.4.3 New Attributes in International Pharmacy Model

The model as proposed will require a number of new attributes to be created in SNOMED CT to support associations between concepts. These are:
6.2.3.7.4.3.1 Plays therapeutic role

Because one of the main consequences of the new draft standard is a revision of the upper levels of the Pharmaceutical and Biological product hierarchy (any concepts above the Medicinal Entity or Medicinal Entity with Modifier level) to eliminate inappropriate inheritance caused by IS_A overloading, there is a requirement to replace the removed inappropriate data.

Grouping concepts indicating mode of action or structure are to be relocated in a separate part of the Pharmaceutical and Biological product hierarchy under a single parent concept of Therapeutic product group (product).

These relocated concepts are to be associated with the medicine concepts in the main pharmaceutical and biological product hierarchy by a role based Relationship of PLAYS_THERAPEUTIC_ROLE rather than the current IS_A Relationship.

Example:

| propranolol (product) | PLAYS_THERAPEUTIC_ROLE | non-selective beta-blocking agent (product) |

Permissible values include the descendants of the concept Therapeutic product group (product).

This would not be a defining Relationship if not always necessarily true of all subtypes; a non-defining Relationship would be created instead. This Relationship will be used to associate Medicinal Entity (or Medicinal Entity with modifier) concepts from the Pharmaceutical and Biological product hierarchy to concepts within the same hierarchy that identify the mode of action.

One Medicinal Entity (or Medicinal Entity with modifier) concept can have zero to many PLAYS_THERAPEUTIC_ROLE Relationships, depending on whether it has multiple modes of action or the mode of action is unknown or currently unspecified.

The level of specificity for the grouping concepts would be in response to the user community requests or ATC groupings.

See also Revision of upper levels on page 240

6.2.3.7.4.3.2 Has reference BoSS

This attribute identifies the substance used to describe the strength of the NPMP drug product, and provides a Relationship between concepts in the Pharmaceutical/Biologic product hierarchy and concepts in the Substance hierarchy.

Domain and concept modelling details for this attribute will be further specified as part of the expression of strength work.

N.B. The existing HAS_ACTIVE_INGREDIENT attribute is also used to provide a Relationship between the ME drug product concept and concepts in the Substance hierarchy.

When the proposals for the expression of numbers in SNOMED CT are finalised there may be further attributes required to support the full definition of pharmaceutical concepts. This will be the subject of a further document.
6.2.3.7.4.4 Diagram of International Pharmacy Model

Figure 62: The International Pharmacy Model

6.2.3.7.4.5 Impact of Release Format 2 (RF2)

The model as proposed in this and the other associated documents is able to be expressed in the current SNOMED CT Release Format and in the new RF2 format. However neither the current Release Format nor RF2 as it is currently proposed support the expression of numeric values in a machine processable manner. The requirement for machine processable numeric values is necessary to support the expression of pharmaceutical strength in SNOMED CT and to allow the full definition of medicinal product (NPMP) concepts.

Options for the expression of pharmaceutical strength have been requested from the Implementation and Innovation committee and proposals for an amendment to the RF2 Release Format are being circulated in a separate document by that committee for comment. These proposals will permit the representation of numeric values by the use of concrete domains.

Since the proposals for the representation of numeric values are currently undergoing the IHTSDO consultation process any reference in this, or the other associated documents, on representation of strength is therefore illustrative based upon the current view of best practise.
Figure 63: International Pharmacy Model - Noted
6.2.3.7.4.7 International Pharmacy Model - expanded

Figure 64: International Pharmacy Model - Expanded
6.2.3.7.4.8 Populated examples

Figure 65: Abacavir Sulfate 600mg + Lamivudine 300mg Tablet
Figure 66: Human Isophane 70% + Human Neutral 30% Insulin Injection
Figure 67: Buprenorphine 20mcg/hour Patch
Figure 68: Ipratropium Bromide 20mcg/metered dose inhalation
Figure 69: Phenytoin Sodium 100mg Tablets
6.2.3.7.5 Definitions relating to pharmaceutical / biologic product concepts

6.2.3.7.5.1 Virtual Medicinal Product (or clinical drug) VMP

The Virtual Medicinal Product (VMP) is the conceptual representation of one or more clinically equivalent Actual Medicinal Products (AMP) the purpose of which is to support the representation of the fundamental reality of the concept. Its core Description requires product name, strength, dosage form and unit dose where appropriate (see Unit Dose Representation on page 414 for
guidance on the applicability of unit dose representation) but is devoid of explicit or implicit information attributable to the manufacturer or pack.

Example:

<table>
<thead>
<tr>
<th>Name</th>
<th>Strength</th>
<th>Dose form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clemastine</td>
<td>1mg</td>
<td>tablet</td>
</tr>
</tbody>
</table>

The Virtual Medicinal Product concept type is the most granular level of concept representation expressed in the core of SNOMED CT.

In instances where the AMP contains a salt weight as a representation of product dose strength, then the salt form must be represented in the VMP.

Example (product with salt form):

- Synflex 275mg tablet (AMP)

The 275mg strength depicts the amount of Naproxen sodium present and not the amount of base Naproxen.

In this instance, the VMP would be Naproxen sodium 275mg tablet.

6.2.3.7.5.2 Virtual Therapeutic Moiety VTM

A VTM is the abstract conceptual representation of the material (i.e. the product) defining the prescribers therapeutic intent, separate from formulation, dose or strength. The HAS_ACTIVE_INGREDIENT attribute will be assigned at this level. Their descendants will inherit this attribute.

Examples:

- Atenolol (product)
- Chlorthalidone (product)

6.2.3.7.5.3 Virtual Therapeutic Moiety Subtype VTM Subtype

A VTM Subtype is a VTM that contains dose form information and should appear as a child of a VTM. It does not contain the product's strength, and is therefore not a VMP.

Example:

Parenteral epinephrine (product).

Rule: A VTM sub-type will always be included in the hierarchical representation of any new concepts, regardless of the number of sibling terms. For instance, the hierarchy for the drug concept Olmesartan will be as follows:

1. VTM: Olmesartan
2. VTM sub-type Oral Olmesartan
3. VMP Olmesartan 10mg tablet

6.2.3.7.5.4 Combination Virtual Therapeutic Moiety - Combination VTM

A Combination VTM is a VTM that refers to a combination of ingredients and/or product categories.

Examples:

- Pindolol+diuretic
- Piperacillin+tazobactam
- Piperazine+sennosides
- Rifampicin+isoniazid+pyrazinamide

These concepts may be useful to aggregate common classes of VMPs.
Combination VTMs will have as their parent concepts the single constituent VTMs. For example the parent concepts of Pindolol+diuretic could be both Pindolol and Diuretic.

Combination VTMs are appropriate when there is a single delivery agent that contains both agents.

Example:

- Septra tablet is a Sulfamethoxazole + trimethoprim

Multiple ingredient substances such as Co-Amilofruse should not be used as the value of the HAS_ACTIVE_INGREDIENT attribute for these concepts. Instead, multiple single ingredient substances should be applied as the value of the HAS_ACTIVE_INGREDIENT attribute, in this case Frusemide and Amiloride.

6.2.3.7.5.5 Actual Medicinal Product AMP

The Actual Medicinal Product (AMP) is the representation of a single unit dose of a medicinal product that is (or has been) made or marketed by a specific manufacturer or supplier. Its core Description requires product name, strength, dosage form, flavour (where applicable) and manufacturer/supplier, but is devoid of explicit information attributable to pack size.

Because they represent domain specific facts Actual Medicinal Product concepts will not be expressed within the core of SNOMED CT, but exist wholly within any suitably identified domain extension.

Example:

- Zyrtec 10mg tablet

6.2.3.7.5.6 Product Category

A Product Category concept supports a group of Pharmaceutical / biologic products related by their functionality or drug/product class. A specific ingredient does not define these concepts.

Examples:

- Sex hormone product (product)
- Mineralocorticoid preparation (product)
- beta-Blocking agent (product)
- Tissue plasminogen activator preparation (product)

It is proposed that future authoring will see all Product Categories standardised as preparations as opposed to using a combination of descriptors e.g. products, agents, etc.

6.2.3.7.5.7 Active Ingredient

Any drug component that is intended to furnish pharmacological activity or other direct effect in the diagnosis, cure, mitigation, treatment, or prevention of disease, or to affect the structure or any function of the body of man or other animals.  

6.2.3.7.5.8 Substance

The chemical ingredients of products, reside in Substance hierarchy in the SNOMED CT core

Values of Has_active ingredient, Direct Substance, Component, Causative agent

6.2.3.7.5.9 Biologic Product

Any virus, therapeutic serum, toxin, antitoxin or analogous product applicable to the prevention, treatment or cure of diseases or injuries in man.

6.2.3.7.5.10 Drug

Any article intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease in man.

---

6.2.3.11 Drug Product

A finished dosage form (tablet, capsule, solution, etc.) that contains an active drug ingredient generally, but not necessarily, associated with inactive ingredients. This also includes a finished dosage form that does not contain an active ingredient but is intended to be used as a placebo.\(^\text{21}\)

6.2.3.8 Organism

This hierarchy includes organisms of significance in human and animal medicine. Organisms are also used in modeling the causes of diseases in SNOMED CT. They are important for public health reporting of the causes of notifiable conditions and for use in evidence-based infectious disease protocols in clinical decision support systems. Sub-hierarchies of organism include, but are not limited to: Animal (organism), Microorganism (organism), Kingdom Plantae (organism).

**Examples of Organism concepts:**
- Streptococcus pyogenes (organism)
- Texon cattle breed (organism)
- Bacillus anthracis (organism)
- Lichen (plant) (organism)

6.2.3.9 Substance

The hierarchy contains concepts that can be used for recording active chemical constituents of drug products, food and chemical allergens, adverse reactions, toxicity or poisoning information, and physicians and nursing orders. Concepts from this hierarchy represent general substances and chemical constituents of Pharmaceutical / biologic product (product) which are in a separate hierarchy. However, sub-hierarchies of Substance also include but are not limited to: Body substance (substance) (concepts to represent body substances); Dietary substance (substance); Diagnostic substance (substance).

**Examples of Substance concepts:**
- Insulin (substance)
- Methane (substance)
- Chromatin (substance)
- Dental porcelain material (substance)
- Albumin (substance)
- Endorphin (substance)
- Acetaminophen (substance)

Combined substances added to the Substance hierarchy that are intended to be used as ingredients for pharmaceuticals must meet the following criteria:
- The physiologic or biologic action of the combination must be enhanced or synergistic
- Combinations that do not have an enhanced or synergistic effect (e.g. combinations created for convenience) are out of scope.

Examples of combined substances that are in scope include:
- ampicillin + sulbactam
- piperacillin + tazobactam

Combined substances are in scope when useful to represent the results of laboratory tests.

Examples of combined substances that are in scope because the value reported by a laboratory measurement is a single combined total of multiple substances include:
- kynurenate + xanthurenic
- trypsin + trypsinogen

6.2.3.10 Specimen

The Specimen hierarchy contains concepts representing entities that are obtained (usually from a patient) for examination or analysis. Specimen concepts can be defined by attributes which specify: the normal or abnormal body structure from which they are obtained; the procedure used to collect the specimen; the source from which it was collected; and the substance of which it is comprised.

**Examples of Specimen concepts:**
- Specimen from prostate obtained by needle biopsy
- Urine specimen obtained by clean catch procedure
- Calculus specimen
- Cerebroventricular fluid cytologic material

**Note:** See also Attributes used to define Specimen concepts.

6.2.3.11 Physical object

Concepts in the Physical object hierarchy include natural and man-made objects. One use for these concepts is modeling procedures that use devices (e.g. catheterisation).

**Examples of Physical object concepts:**
- Military vehicle
- Implant, device
- Artificial kidney, device
- Latex rubber gloves
- Book
- Pressure support ventilator
- Vena cava filter

**Note:** See also Attributes used to define Physical Object concepts.

6.2.3.12 Physical force

The concepts in the Physical force hierarchy are directed primarily at representing physical forces that can play a role as mechanisms of injury.

**Examples of Physical force concepts:**
- Spontaneous combustion
- Alternating current
- Friction

6.2.3.13 Event

The Event hierarchy includes concepts that represent occurrences (excluding procedures and interventions).

**Examples of Event concepts:**
- Flood
- Bioterrorist attack
- Earthquake

**Note:** See also Attributes used to define Event concepts.

6.2.3.14 Environments and geographic locations

The Environment or geographical location hierarchy includes types of environments as well as named locations such as countries, states, and regions.
Examples of Environments and geographic locations concepts:

- Canary islands (geographic location)
- California (geographic location)
- Rehabilitation department (environment)
- Intensive care unit (environment)

6.2.3.15 Social context

The hierarchy contains social conditions and circumstances significant to healthcare. Content includes such areas as family status, economic status, ethnic and religious heritage, lifestyle, and occupations. These concepts represent social aspects affecting patient health and treatment. Some sub-hierarchies of Social context and concepts typical of those sub-hierarchies are shown in the following examples.

Examples:

- Ethnic group (ethnic group):
  - Afro-Caribbean (ethnic group)
  - Estonians (ethnic group)
- Occupation (occupation):
  - Bank clerk (occupation)
  - Carpenter, general (occupation)
- Person (person):
  - Employer (person)
  - Boyfriend (person)
  - Caregiver (person)
- Religion/philosophy (religion/philosophy):
  - Hinduism (religion/philosophy)
  - Orthodox Christian religion (religion/philosophy)
- Economic status (social concept):
  - Middle class economic status (social concept)

6.2.3.16 Staging and scales

This hierarchy contains such sub-hierarchies as Assessment scales (assessment scale), which names assessment scales; and Tumor staging (tumor staging), which names tumor staging systems.

Examples of Assessment scales (assessment scale) concepts:

- Glasgow coma scale (assessment scale)
- Stanford Binet intelligence scale (assessment scale)

Examples of Tumor staging (tumor staging) concepts:

- International Federation of Gynecology and Obstetrics (FIGO) staging system of gynecological malignancy (tumor staging)
- Dukes staging system (tumor staging)

6.2.3.17 Qualifier value

The hierarchy contains some of the concepts used as values for SNOMED CT attributes that are not contained elsewhere in SNOMED CT. Such a code may be used as the value of an attribute in a defining Relationship in precoordinated definitions, and/or as the value of an attribute
in a qualifier in a postcoordinated expression. However, the values for attributes are not limited to this hierarchy and are also found in hierarchies other than the Qualifier value hierarchy.

For example, the value for the attribute LATERALITY in the concept shown below is taken from the Qualifier value hierarchy:

- | Left kidney structure | | LATERALITY | | Left | .

However, the value for the attribute FINDING SITE in the concept shown below is taken from the Body structure hierarchy, not the Qualifier value hierarchy.

- | Pneumonia | | FINDING SITE | | Lung structure | .

**Examples of Qualifier value concepts:**

- | Unilateral |
- | Left |
- | Puncture - action |

### 6.2.3.18 Special concept

The Top Level Concept Code | Special concept | and its subclass codes provide a place for concept codes that are no longer active in the terminology.

The subclasses of | Special concept | are:

- | Navigational concept |
- | Inactive concept |

#### 6.2.3.18.1 Navigational concept

These concept codes are to be used only as nodes in alternative navigation structures. Navigational concepts are distributed as active concepts, with an inactive Is-a Relationship to the concept "Navigational concept". These concepts should have no subtypes.

#### 6.2.3.18.2 Inactive concept (RF2)

When a concept is no longer intended for active use, the concept and its Relationships are turned inactive. Previously, in RF1, the concept was moved into a special "Inactive concept" hierarchy, this is not done anymore in RF2, the concept is inactivated "in place", with its last location described in the history of its inactive Relationships.

#### 6.2.3.18.3 Namespace concept

The concept 370136006 | Namespace concept (namespace concept) | is a subtype of | SNOMED CT model component |. Each of its subtype concepts has an integer term which is an assigned Extension namespace identifier.

### 6.2.3.19 Record artefact

A Record artifact is an entity that is created by a person or persons for the purpose of providing other people with information about events or states of affairs. In general, a record is virtual, that is, it is independent of its particular physical instantiation(s), and consists of its information elements (usually words, phrases and sentences, but also numbers, graphs, and other information elements). Record artifact need not be complete reports or complete records. They can be parts of larger Record artifact. For example, a complete health record is a | Record artifact | that also may contain other | Record artifact | in the form of individual documents or reports, which in turn may contain more finely granular | Record artifact | such as sections and even section headers.

### 6.2.3.20 Core metadata concept

Subtypes of | Core metadata concept | provide structural information required to support International Release data. This supporting information includes sets of enumerated values that apply to attributes of concepts, descriptions and relationships.
6.2.3.21 Foundation metadata concept

Subtypes of the Foundation metadata concept provide supporting metadata and structural information for derivative release structures including Reference Sets.

6.2.3.22 Linkage concept

Linkage concept codes are intended to link two or more other codes to each other to express compositional meanings. All concept codes that can be used as a Relationship Type are included under Linkage concept. The ones approved for use are the Concept Model Attributes. Implementation guidance is as yet quite limited for the other Linkage concept codes. Use of them should be regarded as non-standard, tentative and experimental, requiring extra care.

Linkage concept is a subclass of SNOMED CT model component, and the Linkage concept hierarchy contains the sub-hierarchies:

- Link assertion
- Attribute

Note: In RF1, Linkage concept was a top level hierarchy.

6.2.3.22.1 Link assertion

The Link assertion sub-hierarchy enables the use of SNOMED CT concepts in HL7 statements that assert relationships between statements. Currently this content supports the UK NHS Connecting for Health requirements for encoding of Statement relationships for the implementation of HL7 Version 3 messaging in the UK realm.

Examples of Link assertion concepts:

- Has reason
- Has explanation

6.2.3.22.2 Attribute

Concepts that descend from this sub-hierarchy are used to construct relationships between two SNOMED CT concepts, since they indicate the relationship type between those concepts. Some attributes (relationship types) can be used to logically define a concept (defining attributes). This sub-hierarchy also includes non-defining attributes or attributes that may be useful to model concept definitions but which have not yet been used in modelling precoordinated concepts in SNOMED CT.

Examples of Defining attributes:

- is a
- Concept model attribute:
  - Laterality
  - Procedure site
  - Finding site
  - Associated morphology

Examples of Non-defining attributes:

- Unapproved attribute
  - Relieved by
  - Has assessment

6.2.4 Terming and Naming Conventions

This Part of the Editorial Guide provides chapters that explain and specify the conventions for construction and formation of terms and names, including word order, spelling, punctuation, verb tense, abbreviations, acronyms, and related issues.
6.2.4.1 Introduction to Terms and Descriptions

Terms are character strings that consist of words, phrases and other human-readable representations that convey the meanings of concepts. A term in connection to a particular concept is called a Description. Descriptions may be of several different types. Refer to the SNOMED CT Technical Implementation Guide for specific background on the different types of Descriptions that are recognised in the International Release. This document refers to two commonly used Description types, Fully Specified Name (FSN) and Synonym, and it also refers to Preferred Terms. Preferred Term is not a Description types but is the name given to a Synonym which is marked as preferred in a particular language or dialect.

6.2.4.1.1 Fully Specified Name

Each concept has at least one Fully Specified Name (FSN) intended to provide an unambiguous way to name a concept. The purpose of the FSN is to uniquely describe a concept and clarify its meaning. The FSN is not a commonly used term or natural phrase and would not be expected to appear in the human-readable representation of a clinical record.

A concept may have more than one FSN, but only one of these may be marked as preferred in a given language. A Language Reference Set is used to specify which FSN descriptions is preferred in each language or dialects. The original fully specified name (the first FSN created for a concept) is the ultimate source of reference, if FSNs in different languages have conflicting meanings. Most original FSNs are in US English and, as many translators choose not translate FSNs, the original FSN is preferred by default.

Note: The term in each FSN is unique across the entire active content of a SNOMED CT release.

Each FSN term ends with a “semantic tag” in parentheses. The semantic tag indicates the semantic category to which the concept belongs (e.g. clinical finding, disorder, procedure, organism, person, etc.). The “semantic tag” helps to disambiguate different concepts which may be referred to by the same commonly used word or phrase.

Example: | Hematoma (morphologic abnormality) | is the FSN of the concept that represents the “hematoma” that a pathologist sees at the tissue level. In contrast, | Hematoma (disorder) | is the FSN of the concept that represents the clinical diagnosis that a clinician makes when they decide that a person has a “hematoma”.

6.2.4.1.2 Synonym

A synonym represents a term, other than the FSN, that can be used to represent a concept in a particular language or dialect.

Each concept one or more descriptions of type synonym in each language. A description of type synonym contains a term that represents a word or phrase, other than the term in the fully specified name that can be used to represent a concept. One synonym for each concept is marked as preferred in each dialect and the associated term is called the preferred term for that concept.

The use of a description can vary between different languages, dialects and contexts, so a description may be preferred in some dialects, acceptable for use in other dialects and may not used in some dialects. A Language Reference Set is used to specify the descriptions that are acceptable or preferred in each language or dialect.

Example: Synonyms of the concept 22298006 | myocardial infarction (disorder) | in English include:

- | cardiac infarction | (Description.id: 37442013);
- | heart attack | (Description.id: 37443015);
- | infarction of heart | (Description.id: 37441018);
- | myocardial infarction | (Description.id: 37436014).

The synonym | myocardial infarction | (Description.id: 37436014) is marked as preferred in the US English Language Reference Set. Thus in US English this is the preferred term.

Note: Unlike fully specified names, synonyms are not required to be unique.
6.2.4.1.3 Preferred Term

The preferred term is the preferred common word or phrase used by clinicians to name that concept in a particular language, dialect or context. Each concept has one to more descriptions of type synonym in each language. In each language or dialect one of these description is marked as preferred and is the preferred term for that concept.

The use of a description can vary between different languages, dialects and contexts, so a description may be preferred in some dialects, acceptable for use in other dialects and may not used in some dialects. A Language Reference Set is used to specify the descriptions that are acceptable or preferred in each language or dialect.

Example: The concept 54987000 | repair of common bile duct (procedure) | has a description of type synonym | choledochoplasty |. This is marked as preferred in the US English Language Reference Set. Therefore, | choledochoplasty | is the preferred term for this concept in US English.

Note: Unlike the fully specified name (FSN) the preferred terms need not be unique. Occasionally, the preferred term for one concept may also be a synonym for a different concept. Interpretation in these cases will depend on context of use.

Example:

- | Cold sensation quality (qualifier value) | has a preferred term of “Cold”;
- | Common cold (disorder) | also has a synonym of “Cold”.

In both cases, “cold” represents a common clinical phrase used to capture the meaning of the concept.

Note: Selection of one term over another as “preferred” in a given language dialect depends entirely on whose preferences are being expressed. Different users are likely to have different preferences, and implementers are encouraged to select terms that properly represent the concept and meet the preferences of users. There is no expectation that the preferred term distributed with a given language dialect will meet all use cases; nor is there anything sacrosanct about the term. The US English preferred term has no special status relative to other terms. Rather, it is merely one term that properly represents the concept and can be used as a starting point.

6.2.4.2 General criteria - all term types, all hierarchies

6.2.4.2.1 Plurals

In general, terms are represented in the singular rather than the plural.

For example:

- | breast procedure | instead of | Breasts procedure |
- | Disorder of lung | instead of | Disorder of lungs |
- | Adrenal imaging | instead of | Adrenals imaging |

6.2.4.2.1.1 Exceptions

Organisational nodes, also called “grouper” concepts, may have a synonym that is plural. There is a special term type for these plurals.

For example:

- | Procedures for splenic lesions |
- | Diseases of mitral and aortic valves |

Fully-specified names should not be given in plural form unless the concept necessarily involves multiples. Unintended plurals might mislead data analysts into incorrectly inferring there were multiples when there was in fact only one.

An unintended plural is the use of a plural in a name for a code that might be attached to a case where there is only one of the entity being coded.

For example, consider "trochlear lesion" versus "trochlear lesions": Since users will want to use this code to refer to a single trochlear lesion, the singular form of "lesion" is correct, and the plural form would be incorrect.
As another example, consider “multiple cranial nerve palsies”. In this case, the word “multiple” indicates that there can never be just one, so a plural form of “palsies” is correct, and the singular would be incorrect.

Note that these rules apply to the FSN, and should apply to preferred display names to be used in coding. Exceptions to these rules might be allowed for special synonyms used for navigation, where the broad category is more naturally named using a plural. However, it would be advisable to keep track of these exceptions in a separate subset or using a special term type so that they can be excluded when the singular/plural distinction is important for coding.

6.2.4.2.2 Punctuation

6.2.4.2.2.1 Apostrophes

Eponymous terms should ideally not include an apostrophe or final "s" (unless the name normally ends in "s"). With rare exceptions, concepts with any eponymous terms should have at least one term that follows this rule.

For example:

- Down syndrome |
- Sjogren syndrome |
- Meigs syndrome |

On the other hand, in common usage the preferred name frequently does include the apostrophe "s". Where common usage requires it, there should be at least one term that has the apostrophe “s”. Existing eponymous terms with the possessive “s” but no apostrophe need not be retired, but newly added terms should either have no “s”, or else include the apostrophe. For terms with a possessive apostrophe where the name normally ends in "s", the apostrophe should of course follow the "s". There should be no hyphen in between the two words.

For example:

- Alzheimer's disease |
- Bowen's disease |
- Reiter's disease |
- Meigs' syndrome |

6.2.4.2.2.2 Special characters

The special characters &, %, $, @, # are not permitted in FSNs. All instances of FSNs containing any of these characters need to be spelled out in full text. E.g. "FD&C Yellow #2" should be “FD and C Yellow Number Two”.

The characters @ and $ are not used in any active term, regardless of term type, and new descriptions containing these characters should be avoided.

The characters &, %, and # are legitimately used in some synonyms including preferred terms.

6.2.4.2.2.3 Hyphens and dashes

A hyphen is a punctuation mark used to join words and to separate syllables. There should be no spaces either before or after the hyphen. Hyphens should follow rules of style for the dialect and language in which the terms are used.

For example:

- intra-articular |
- Zollinger-Ellison syndrome |
- Zellweger's-like syndrome |
- tick-borne hemorrhagic fever |
- phospho-2-dehydro-3-deoxygluconate aldolase |

A dash is also a punctuation mark, but is used differently from a hyphen. It may be used to separate two phrases or names, to contrast values, to show a Relationship between two things, or to separate ranges of values.

Dashes (as opposed to hyphens) should not be used in FSNs (with rare exceptions) because they may obscure the exact meaning of the term. The dash should be replaced with words that clarify the meaning.
Table 184: Examples of dashes that should not be used in FSNs, and a replacement phrase:

<table>
<thead>
<tr>
<th>Not acceptable for FSN:</th>
<th>Use instead:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y90 - Yttrium 90</td>
<td>Yttrium 90</td>
</tr>
<tr>
<td>Aeronautical engineer - feasibility studies</td>
<td>Aeronautical engineer involved in feasibility studies</td>
</tr>
<tr>
<td>On examination - breath urinose - uremic</td>
<td>on examination, breath urinose implying uremic subject</td>
</tr>
<tr>
<td>O/E - bowel sounds exaggerated</td>
<td>On examination, bowel sounds exaggerated</td>
</tr>
<tr>
<td>Disability - all limbs</td>
<td>Disability of all limbs</td>
</tr>
</tbody>
</table>

Exceptions to the use of dashes: Where there is a need to distinguish categories from more specific subtypes that have the same name, it is sometimes expedient to use a dash followed by the word "category". For example, "glioma - category" distinguishes the general category of all gliomas from those neoplasms that are called simply "glioma". The neoplasm specifically called "glioma" is one of several subtypes of the glioma category, and does not have the same meaning as the category itself. Many classifications distinguish the category from the subtype of the same name by using a plural for the category. For example, ChEBI has a category called "amphetamines" and a specific molecular entity called "amphetamine".

6.2.4.2.2.4 Colons

Colons should not be used in FSNs.

Exceptions: Colons are allowed in the FSNs of organisms, substances, or products where the colon is a proper part of the name. They are also allowed in ratios and in tumour stages.

For example:

- | Salmonella II 43:g.t.[1,5] (organism) |
- | lidocaine hydrochloride 1.5%/epinephrine 1:200,000 injection solution vial (product) |
- | pT3: tumor invades adventitia (esophagus) |

Colons are allowed in designations (non-FSN terms) in a variety of contexts. Some common examples of use are to separate acronyms from the rest of a name, and to separate a specimen from the finding identified in that specimen.

For example:

- | FH: Metabolic disorder |
- | H/O: breast problem |
- | Urine: red - blood |

6.2.4.2.2.5 Forward slashes

The forward slash should not be used in FSNs.

Exceptions: A forward slash may be used for representing units of measure, as required in the pharmaceutical products hierarchy, and in laboratory test results and units of measure hierarchies. They may also be used in the construct “and/or” in FSNs. There should be no space either before or after the slash.

For example:

- | Nitroglycerin 0.3mg/hr disc (product) |
- | Mesoridazine besylate 25mg/mL injection solution ampule (product) |
- | Ibuprofen 5% / Levomenthol 3% gel (product) |
- | Bone structure of head and/or neck (body structure) |

A forward slash may be allowed in designations (non-FSN terms) in a variety of contexts. Some common examples of use are in acronyms with findings, and as an abbreviation meaning “and/or” concepts.

For example:

- | O/E - abdominal mass palpated |
6.2.4.2.6 Plus signs (+)

For combination drug products, a "+" sign is allowed and should be used.

6.2.4.2.7 Caret symbols (^)

As a workaround for the lack of markup that would allow proper representation of superscript characters, a pair of caret symbols is used to enclose character strings that properly should be displayed as superscript.

For example:

- | Technetium Tc^99c medronate (substance) |
- | Blood group antigen Sd^a (substance) |

Representing exponents: In alignment with the Unified Code for Units of Measure (UCUM) guidance on the use of powers of ten, the single caret is used to represent exponents, i.e. "powers of". For example, "10^3" for the third power of ten is acceptable.

6.2.4.2.3 Eponyms

Eponyms are names that are derived from a proper name, usually the name of a person who discovered or described the thing originally. They are commonly found in a wide variety of names in health terminology, ranging across diverse areas such as anatomic structures, morphologic abnormalities, blood groups, diseases, findings, and procedures.

For example:

- | Rutherford Morrison's pouch |
- | vein of Galen |
- | Aschoff body |
- | Kell blood group |
- | Down syndrome |
- | Moro reflex |
- | Whipple procedure |

It is neither desirable nor indeed possible to completely avoid the use of eponyms in a health terminology. Nevertheless, FSNs should avoid including eponyms wherever possible in order to improve clarity of meaning and to facilitate translation to other languages. The full Description should be used as the FSN, and the eponymous term can be added as a synonym. For example, the FSN for “Moro reflex” should use the phrase “infant startle reflex.”

Exceptions are allowed when the full Description is exceptionally long and unwieldy. An example of allowed exception is “Hemi-Fontan operation (procedure).” This operation is defined as a “bidirectional Glenn shunt with end-to-side anastomosis of proximal superior vena cava to right pulmonary artery with isolation from right atrium”. The resulting FSN would be too long and unwieldy, so the eponym is allowed in the FSN in this case. Such exceptions require careful attention to the possibility that the acronym’s meaning may change over time.

Exceptions are also allowed for concepts where the eponym is the only precise clinically relevant name available, and where an artificially constructed non-eponymous name would necessarily be vague or subject to significant misinterpretation. Examples include “Hodgkin lymphoma” and “Burkitt lymphoma.”

It is permitted and encouraged to include eponyms as designations (non-FSN terms) whenever they are understandable, reproducible and useful in a given context. For example, the preferred term for “infant startle reflex” may be “Moro reflex.”

6.2.4.2.4 Abbreviations

Abbreviations are prohibited in FSNs and synonyms, with specified exceptions. Where there are exceptions, the specific policy allowing the exceptions must be spelled out in detail in the Editorial Guide, and otherwise terms containing abbreviations are not to be accepted into the International Release.

6.2.4.2.4.1 Acronyms

Acronyms are an abbreviation formed from the initial letters of other words and pronounced as a word (e.g. ASCII, AIDS). Here we reiterate the prohibition of acronyms in fully specified names (see Acronyms in FSNs on page 371. Acronyms can be misinterpreted because they are not fully spelled out.
It is a mistake to assume that everyone will know what an acronym means. Therefore acronyms may not be used in *fully specified names* when the fully spelled out name is available. An exception may be where a sequence of letters started as an acronym but has now become a word in its own right, understood without expansion to its original full form. A common example would be “laser”. Evidence that it is a word in its own right is that it is included in dictionaries in lower case, and the fully spelled-out meaning has become a trivia question. An example of an acronym that may *not* be included in an FSN is “CT” for “computed tomography”. While those involved in imaging and radiology may regard “CT” as a word (pronounced “see tee”), it does not pass the test of being unambiguous, of appearing in a dictionary in lower case, or of its component words being a trivia question.

Acronyms are however allowed in synonyms or preferred terms when accompanied by the full expansion of the abbreviation. Expansions should be enclosed in parenthesis to reduce the technical implementation burden when indexing and searching e.g. CT (Computed tomography).

### 6.2.4.2.5 Verbal nouns

Where possible, the form for the action word describing the clinical action within a FSN and preferred term is the verbal noun ending in "-ion" rather than "-ing".

*For example:*

- “incision” instead of “incising”]
- “destruction” instead of “destroying”

*Exceptions:*

When no other verbal form is available, the "-ing" form may be used. Also, when common usage sanctions the noun form, it may be used.

*For example:*

- “suturing” of tricuspid valve
- “cautery” of wart

### 6.2.4.2.6 Past tense verbal forms and sentence function types

Past tense verbal phrases must not be used to name procedures, since they invoke a temporal context that indicates that the procedure was done. Any existing terms containing past tense verbs should be moved to the situation hierarchy.

Terms for procedures should also be examined for the presence of a phrase that can be categorized as a sentence function type - i.e. imperative, declarative, interrogative, or exclamatory. These should be disallowed in procedure terms. A procedure term should be a noun phrase that names the procedure, and should not contain information that it was done, or is to be ordered, carried out, or planned.

*For example:*

- | Hand tendon ganglion excised | indicates the procedure was done, as a past tense declarative statement. This is a situation with explicit context, not a procedure.
- | Excision of ganglion of tendon sheath of hand | is a noun phrase giving the proper term for the procedure.

### 6.2.4.2.7 Language dialects

All *fully specified names* should be represented in the “US” dialect. When there is a difference in spelling or dialect between the US and UK, the concept should be given a US preferred term and/or synonym and a UK preferred term and/or synonym.

*For example:*

- | Tumor of endocrine pancreas (disorder) | - FSN
- | Tumor of endocrine pancreas | Preferred - GB dialect, Synonym - US dialect
- | Tumor of endocrine pancreas | Preferred - US dialect, Synonym - GB dialect

#### 6.2.4.2.7.1 Reference sources for English spelling variants

For general principles and references, Wikipedia has a summary for editors that is good quality, addresses a large number of US-GB differences, provides reference sources, and appears consistent with what SNOMED CT users have requested over the years:
This guide should be the first point of reference. In addition, specific references for each dialect can be consulted.

For GB Medical English, references include:

- The BMJ: [www.bmj.com/about-bmj/resources-authors/house-style](http://www.bmj.com/about-bmj/resources-authors/house-style)
  - “foetus and fetus are both acceptable in English: the BMJ uses fetus”
- BMJ in turn references the following two sources:
  - Dorland's Medical Dictionary as a preferred dictionary for medical terms
  - Chambers 21st Century Dictionary for general usage

Note: Oxford English Dictionary spelling (en-GB-oed) is different from British English (en-GB). A summary of the points of difference can be found at [http://en.wikipedia.org/wiki/Oxford_spelling](http://en.wikipedia.org/wiki/Oxford_spelling). In those cases where en-GB and en-GB-oed differ, SNOMED CT preferred terms in the British English dialect should follow the en-GB spelling and not en-GB-oed. Addition of an en-GB-oed term is allowed but not required; when added it should be marked as acceptable in the en-GB dialect (and in some cases it will also be either acceptable or preferred in the en-US dialect).

For US Medical English, references include:

- Stedman's Medical Dictionary
- Merriam-Webster Online Dictionary
- AMA Manual of Style

### 6.2.4.2.7.2 Principles for selecting preferred spelling variants

1. SNOMED CT may include (or add) more than one description, each with a different spelling for a given term, if the references cited above provide evidence of acceptability in the dialect(s) for which they are being added.

2. For spelling of preferred terms in a dialect, where the reference sources provide multiple options, a judgment may need to be made about the most commonly adopted spelling. This can sometimes be determined by examining a few articles containing the word in question that are from highly cited journals such as BMJ (for British English) or NEJM or JAMA (for US English). If the term is a non-clinical term, appropriate scientific journals should be consulted, such as Science (published by a U.S. publisher) or Nature (published by a UK publisher).

3. The choice may be arbitrary. In difficult cases it is advisable to just make a choice and move on. It is unlikely that a strict rule covering all borderline cases can be found, and besides, preferences change over time.

### Capitalisation

Capitalise the first word in a term unless this would change its meaning. The rest of the string should be in lower case, except for proper nouns, adjectives derived from proper nouns, and acronyms.

**For example:**

- | Angiokeratoma of Fordyce |
- | Neonatal jaundice with Dubin-Johnson syndrome |
- | CMS supervisory note |
- | WBC enzyme determination |
- | Family Canidae |
- | pH measurement |
- | mm |

### 6.2.4.2.9 Articles

Terms should omit the unnecessary inclusion of articles like “an” and “the”.

**For example:**

- | Neoplasm of respiratory tract | instead of | Neoplasm of the respiratory tract |
6.2.4.2.10 Multiple meanings
A single term can refer to one or more than one meaning, and therefore the fully specified name should be examined in order to resolve any ambiguity.

For example:

- | immunosuppression | may mean the state of being immunosuppressed, or it may mean the procedure of applying immunosuppressive therapy.

6.2.4.2.11 Patient vs Subject
Terms containing the word "patient" should instead use the word "subject" which is more general. For example, "swab taken by patient" should instead be "swab taken by subject". The word "subject" here refers to the subject of the record, who may in some circumstances not actually be considered a patient per se.

6.2.4.3 General criteria - Fully Specified Names
These guidelines should be applied to new content, and the process of applying them to existing content will be carried out as time and resources permit, according to priorities for usage. There are many terms in existing content that are not in compliance with current guidance. This is partly a result of historical practice in the source terminologies, and in some cases a result of multiple competing rules for determining term composition or word order that cannot all be simultaneously satisfied.

It is unrealistic to expect the phrasing pattern or the word order of the Fully Specified Name to ever be able to satisfy the wide variety of sorting and display requirements. Word order consistency for the sake of display or sorting should be achieved by using descriptions other than the Fully Specified Name, and in many or most cases will require the creation of descriptions in an extension and maintained as reference sets designed for this purpose by the end user, vendor, or national release centre.

6.2.4.3.1 Minor changes in the Fully Specified Name
This rule specifies that the Concept does not need to be retired in cases where the Fully Specified Name (FSN) undergoes minor changes. Minor changes in the FSN are those changes that do not alter its meaning. They may include changed capitalisation, punctuation, spelling, acronym expansion or word order revision. Such changes are sometimes necessary in order to achieve a consistent and predictable presentation style, but are allowed only if they do not change the Concept's meaning.

A change to the semantic type shown in parentheses at the end of the FSN may sometimes be considered a minor change if it occurs within a single top-level hierarchy (e.g. a change from a finding tag to a disorder tag, or a change from a procedure tag to a regime/therapy tag), but a move to a completely different top-level hierarchy is regarded as a significant change to the Concept's meaning and is prohibited.

Unlike the Concept, the Description cannot remain unchanged even with minor changes to the term string. If DescriptionType is Fully Specified Name then any change to any character of the term string requires a new Description with a new unique identifier.

6.2.4.3.2 Unique
The FSN is unique among active concept codes.

6.2.4.3.3 Unambiguous
The FSN should provide a linguistic representation of the concept in an unambiguous way. It is considered an anchor for the representation of meaning of a concept, to which modelers can refer when assigning a logic-based definition. The FSN does not necessarily follow the usual phrasing used in clinical practise; it may be phrased differently and may be longer and more fully spelled out in order to represent the meaning as clearly as possible and globally communicate the intended meaning of the concept.

Ambiguity Examples:
The following FSNs are ambiguous because the concept clearly has additional meaning that is not spelled out by the FSN. These FSNs would have to be retired:

- | Standing in water side toward (finding) |
  Note: this FSN does not indicate which side of what is towards what.

- | Lumbar ache - renal (finding) |
Note: this FSN does not clearly convey whether the lumbar ache is must be of a specifically renal etiology or whether the lumbar ache is merely located over the renal area.

Examples of clear FSNs:
- | Benign neoplasm of clavicle (disorder) |
- | Excision of cyst of spleen (procedure) |

6.2.4.3.4 Hierarchy tag

The FSN must end with a hierarchy tag in parentheses that identifies the hierarchy into which the concept is placed via its Relationships.

Examples:
- | Neoplasm of lung (disorder) |

Note: the ‘(disorder)’ hierarchy tag indicates that this concept is in the | disorder | subhierarchy of the clinical finding hierarchy.

- | Appendectomy (procedure) |

Note: The ‘(procedure)’ hierarchy tag indicates that this concept is in the | procedure | hierarchy. Sometimes the hierarchy tag is the only disambiguating factor for the meaning of the FSN.

Examples:
- | Carcinomatosis (disorder) | versus | Carcinomatosis (morphologic abnormality) |

6.2.4.3.5 US English spelling and dialect for the International FSN

The FSN assigned to a concept when the concept is accepted for incorporation into the International Release is designated as the International FSN. The International FSN is considered the gold standard for interpretation of the meaning of the concept, from a linguistic standpoint. Obviously the logical definitions represented using the concept model should represent the same meaning. Spelling of the International FSN follows United States (American) English spelling conventions. Other English language spelling and conventions, such as Great Britain (UK) English, may be represented in Preferred Terms and Other Terms that are appropriately tagged using the language reference set mechanism. (In this document, US English Descriptions are preceded by US, and Great Britain English Descriptions are preceded by GB).

Examples:

FSN: Chronic anemia (disorder)
US PT: Chronic anemia
GB PT: Chronic anaemia

FSN: Ischemic heart disease (disorder)
US PT: Ischemic heart disease
GB PT: Ischaemic heart disease

6.2.4.3.6 FSN for procedures

When possible, the FSN for a procedure should name the action of the procedure (the METHOD) first, and then the object that the action acts directly upon. For some of the examples below, the modelling of the concepts is included to help the user understand the suggested naming conventions.

1. When the direct object of the action is an anatomical site: In this case the word(s) naming the site should follow the word(s) naming the action.
   Example:
   - | Repair of artery (procedure) |
   
   In this case, the action is named by “repair” and the site is named by “artery”.

2. When the direct object of the action is a device: In this case the word(s) naming the device should follow the word(s) naming the action. If there is a site that is not the direct object of the action, the word(s) naming it should come after the word(s) naming the device.
Example:
| Insertion of catheter into artery (procedure) |
In this case, the action is named by "insertion," the direct object is named by "catheter," and the indirect site is named by "artery."

3. **When the direct object of the action is a substance:** In this case, the word(s) that name the substance should follow the words that name the action. If there is a site that is not the direct object of the action, the word(s) naming it should follow the word(s) naming the substance.

Example:
| Injection of hormone into subcutaneous tissue (procedure) |
In this case, "injection" is the action, "hormone" is the direct object, and "subcutaneous tissue" is the indirect site.

4. **When the direct object of the action is a morphologic abnormality:** In this case, the morphology term should follow the action term. If there is a site mentioned, it should follow the morphology term.

Examples:
| Excision of cyst of breast (procedure) |
In this example, "excision" is the action, "cyst" is the morphology, and "breast" is the site. The "cyst" is the direct object of the action.

| Operation on aneurysm of carotid artery (procedure) |
Here the action is "operation," the direct object is the morphologic abnormality "aneurysm," and the site is "carotid artery."

6.2.4.3.6.1 Past tense verbal forms and sentence function types

Past tense verbal phrases must not be used to name procedures, since they invoke a temporal context that indicates that the procedure was done. Any existing terms containing past tense verbs should be moved to the situation hierarchy.

Terms for procedures should also be examined for the presence of a phrase that can be categorized as a sentence function type - i.e. imperative, declarative, interrogative, or exclamatory. These should be disallowed in procedure terms. A procedure term should be a noun phrase that names the procedure, and should not contain information that it was done, or is to be ordered, carried out, or planned.

For example:

- | Hand tendon ganglion excised | indicates the procedure was done, as a past tense declarative statement. This is a situation with explicit context, not a procedure.
- | Excision of ganglion of tendon sheath of hand | is a noun phrase giving the proper term for the procedure.

6.2.4.3.7 FSN for clinical findings

When possible, the FSN for a Clinical finding should name the morphologic abnormality before naming the site.

Examples:
| Inflammation of ampulla of Vater (disorder) |
Here the morphologic abnormality is inflammation and the site is "ampulla of Vater."

| Edema of hand (finding) |
In this case "oedema" names the morphologic abnormality and "hand" names the site.

6.2.4.3.8 Acronyms in FSNs

Acronyms are easily misinterpreted and therefore an FSN is not fully specified if an acronym is not spelled out in full. For this reason, all acronyms are banned from FSNs. In those cases where it is found that there is an acronym in an FSN, the FSN DescriptionId will be retired and a new FSN will be created. This is to occur whether the acronym was enclosed in parentheses with an expansion or not. In the replacement FSN term, the acronym will be entirely removed and replaced by its expansion. This does
not necessarily require the retirement of the ConceptId, unless the meaning of the FSN had significant ambiguities before expanding the acronym.

Example:

| Computed tomography of chest (procedure) | instead of | CT of chest (procedure) |

6.2.4.4 General criteria
6.2.4.4.1 The Preferred Term

The Preferred Term (PT) represents a common word or phrase used by clinicians to name a concept in clinical practise or in the literature. Only one of the available Descriptions can be designated as preferred. Depending on the computer application, the PT may be the Description selected for display, although each application is assumed to be allowed to independently determine the most appropriate display term for a given situation.

Examples:

| FSN: Pharyngectomy (procedure) | PT: Pharyngectomy | Synonym: Excision of pharynx |

Note: This concept existed prior to the naming convention guidelines in this document. According to these guidelines, if this concept did not exist and was to be proposed as a new addition, its FSN should be “Excision of pharynx (procedure)”. The choice of PT (“pharyngectomy” or “excision of pharynx”) depends on the preference of the submitter and/or the reviewers. Where there is no clear preference, or where preferences vary, the choice of PT is currently arbitrary and unsystematic.

| FSN: Blepharitis (disorder) | PT: Blepharitis | Synonym: Inflammation of eyelid |

Note: According to naming conventions in this document, this concept would be given an FSN of “Inflammation of eyelid (disorder).” Either of the non-FSN Descriptions could be chosen as the PT.

| FSN: Catheterisation (procedure) | PT: Catheterisation | Synonym: Insertion of catheter |

Note: Following the naming conventions, the FSN of this concept would be “Insertion of catheter (procedure).” Either of the non-FSN Descriptions could be chosen as the PT.

| FSN: Fracture of coccyx (disorder) | PT: Fracture of coccyx |

Note: In this case the PT is the same as the FSN without the hierarchy tag “(disorder).” The term “coccygeal fracture” would be an equally acceptable PT.

6.2.4.4.2 Synonyms

A synonym is a term with the same meaning as another term. Terms that are synonyms are said to be synonymous, and the state of being a synonym is called synonymy. Addition of the same term as a synonym to more than one concept will not usually be acceptable, but of course some terms have more than one meaning. When a term can take more than one meaning, the term may be attached to multiple concepts without violating this rule. Where multiple concepts have an identical term as a synonym, a review will be undertaken to ascertain if the concepts involved are duplicates. Where the concepts are duplicates, one concept will be retired with a SAME_AS relationship to the concept it duplicated.
Where a term with a single meaning is associated with more than one concept (which are not duplicates), the term should be retained on only one of the concepts and retired on the other(s).

In some cases a general term may be acceptable as a synonym for two or more specific concepts, depending on the context of use to derive proper specificity (e.g. “fundus” in the context of obstetrics vs ophthalmology). It is expected that these occasions will be unusual, and should be highlighted as exceptions, to assist with proper usage. Editorial guidance for broader synonyms should be taken into account.

6.2.4.4.3 Narrower synonyms
If a synonym is more specific than the FSN this is an error, since it does not have the same meaning. Concepts with synonyms more specific than the FSN are considered ambiguous, since they could have the general meaning of the FSN or the specific meaning of the erroneously attached synonym.

Example:
FSN: | Removal of device (procedure) |
SYN: | Removal and replacement of prosthetic device |

6.2.4.4.4 Broader synonyms
When a synonym is more general than the FSN, and there is no common context in which it has the same meaning as the FSN, the concept should be retired as ambiguous.

Example:
FSN: | Sprain (morphologic abnormality) |
SYN: | Joint injury |

However, a more general synonym is considered valid when there is a context where the more general synonym has the same meaning as the FSN.

Example:
FSN: | Entire fundus uteri (body structure) |
SYN: | Fundus | in the context of obstetrics.

These valid broader synonym terms should be marked using the “degree of synonymy” field in the language reference set, with value “near synonymous (depending on context of use)”.

6.2.4.5 General rules for naming conventions for specific hierarchies
Generally desired features of naming conventions:
1. The convention should be consistent and reproducible.
2. The convention should follow “natural” language when possible.
3. The meaning of phrases generated by the convention should be unambiguous to users and across linguistic barriers for translation purposes.
4. Conventions should not attempt to address needs for variations based on word order preferences (e.g. for searching or display). The creation of multiple word order variants for these purposes is considered outside the scope of the International Release of SNOMED CT.

6.2.4.6 Naming conventions for the disorder hierarchy
In the disorder hierarchy, the word ‘disorder’ in singular should be used. When the concept is a general grouper of disorders of a body system, body site, or other broad general category, the word ‘disorder’ should be used in preference to ‘disease’ for the FSN. This rule in favour of ‘disorder’ over ‘disease’ applies only to broad groupers, and is not applied at ‘leaf’ level. Plurals such as ‘disorders’ or ‘diseases’ may only be used in synonym terms for grouper concepts. Strings should avoid the article ‘the’ in the string.
Table 185: Examples of use of the words ‘disorder’ and ‘disease’ for general groupers:

<table>
<thead>
<tr>
<th>At a general level, use:</th>
<th>Instead of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disorder of nose</td>
<td>Diseases of the nose</td>
</tr>
<tr>
<td>Disorder of reproductive system</td>
<td>Disease of reproductive system</td>
</tr>
<tr>
<td>Disorder of lower respiratory system</td>
<td>Disease of lower respiratory system</td>
</tr>
</tbody>
</table>

6.2.4.7 Naming conventions for measurement procedures
6.2.4.7.1 Convention for the FSN for measurement procedures:

General naming pattern: Action, Analyte, Specimen

- First component: Action
  This is consistent with the general rule followed for the FSN for new procedure concepts. The action (the value of METHOD) is named first when possible.
  - Modifier of the first component: Scale Method
    Scale Method refines the Action, and therefore will precede the action in the naming order. (Scale Method, Action)
  - Naming pattern: (Scale Method, Action), Analyte, Specimen

- Second component: Analyte
  This is also consistent with the general rule followed for FSNs for new procedure concepts. Where possible, the action (the METHOD) is named first followed by the object acted directly upon. Applying this convention to measurement procedures, the object being acted directly upon (measured) is the Analyte.

- Third component: Specimen
  - Modifier of third component: Timing
    Timing provides information about the specimen, and will therefore precede it in the naming order. (Timing, Specimen)

- Word order for additional properties
  Additional properties such as ratio, concentration, percentage, and count will follow the action.

Measurements done by screening should be specified with “by screening method” added at the end of the term

Example:
Measurement of substance X in Y specimen by screening method

6.2.4.8 Naming conventions for clinical imaging procedures

Almost all imaging procedures can be unambiguously expressed in a number of ways and there is a balance to be struck between allowing flexibility in language use and efficient terminology maintenance so all variants for all modalities will not routinely be included in SNOMED CT – any over and above those optimal descriptions following must be justified explicitly.

As a minimum, procedures will ordinarily be expressed in terms of the modality and body site (represented as ‘X’ in the following illustrations).

There are a number of inconsistencies in existing content, but it is not required that these naming conventions necessarily be applied wholesale to that content. It is definitely intended for new content. Changes to existing content to conform to these guidelines will be considered based on value to users.

6.2.4.8.1 X-ray imaging

Two possible approaches have been discussed, and final resolution has not yet been reached.

Option 1:
Descriptions:
FSN: Radiography of X (procedure)
PT: Radiography of X
Option 2:
Descriptions:
FSN: X-ray of X (procedure)
PT: X-ray of X
Discussion:
There is a need to differentiate a grouper for all imaging procedures that utilize X-rays, from plain X-rays. The goal for this guidance is plain X-rays of a site. Given the apparent lack of consensus, the solution probably will involve a text definition and a naming convention specific to SNOMED CT, with advice to implementers.

6.2.4.8.2 Computed tomography

The convention of describing these as Computerised Axial Tomography (CAT) has ceased to be accurate because of the “axial” part of the phrase; several alternative techniques may be used to create images in multiple planes or axes.

Computed tomography descriptions will **not** routinely include:

- **Computed tomography scan of X**
  The word "scan" will not be systematically added in new descriptions, and should not be included in the preferred description. However, if a specific request is received to add a description with the word "scan", it will not be denied.
- **Computerized axial tomography scan of X**
  This term and its abbreviation "CAT scan" are considered obsolete, and will not be added as new descriptions.

To avoid retirement of existing computed tomography concepts, existing FSNs that do not follow this terming guide will not be changed. A batch change of the FSNs without retirement of the concepts would require Committee approval.

Descriptions:
FSN: Computed tomography of X (procedure)
PT: CT of X

Synonym: Computed tomography of X

- **Computed tomography angiography**
  Descriptions:
  FSN: Computed tomography angiography of X (procedure)
  PT: CT angiography of X
  Synonym: CT angiogram of X
  Synonym: Computed tomography angiography of X

- **Computed tomography arthrography**
  Descriptions:
  FSN: Computed tomography arthrography of X (procedure)
  PT: CT arthrography of X
  Synonym: CT arthrogram of X
  Synonym: Computed tomography arthrography of X

- **Computed tomography venography**
Venography may simply be a timing phase of angiography. It is agreed that venography can be a useful term in the FSN and that there is a meaningful technique difference between simple angiography and purposeful venography.

### 6.2.4.8.3 Ultrasonography

Descriptions:
- FSN: Ultrasonography of \( X \) (procedure)
- PT: Ultrasonography of \( X \)
- Synonym: Ultrasound scan of \( X \)
- Synonym: Ultrasound of \( X \)

  - Doppler ultrasonography
    Descriptions:
    - FSN: Doppler ultrasonography of \( X \) (procedure)
    - PT: Doppler ultrasonography of \( X \)
    - Synonym: Doppler ultrasound scan of \( X \)
    - Synonym: Doppler ultrasound of \( X \)

  - Obstetric ultrasonography
    Note - Obstetric ultrasound scans are more complex to describe and often much additional clinical information needs to be described. However in terms of the modality the same rules are applied as follows:
    Descriptions:
    - FSN: Obstetric ultrasonography of \( X \) (procedure)
    - PT: Obstetric ultrasonography of \( X \)
    - Synonym: Obstetric ultrasound scan of \( X \)
    - Synonym: Obstetric ultrasound of \( X \)

### 6.2.4.8.4 Magnetic resonance imaging

It has been agreed that MRI and MR are exceptions to the rule that all abbreviations should be accompanied in a description by their expanded form in parentheses.

It was agreed that the use of near synonyms is acceptable for these procedures (i.e. angiogram/arteriogram).

Descriptions:
- FSN: Magnetic resonance imaging of \( X \) (procedure)
- PT: MRI of \( X \)
- Synonym: Magnetic resonance imaging of \( X \)

  - Magnetic resonance angiography
    Descriptions:
    - FSN: Magnetic resonance angiography of \( X \) (procedure)
    - PT: Magnetic resonance angiography of \( X \)
Synonym: Magnetic resonance angiogram of X
Synonym: Magnetic resonance angiography of X
Synonym: MR angiography of X

• Magnetic resonance venography
  Descriptions:
  FSN: Magnetic resonance venography of X (procedure)
  PT: Magnetic resonance venography of X
  Synonym: Magnetic resonance venogram of X
  Synonym: Magnetic resonance venography of X
  Synonym: MR venography of X

• Magnetic resonance arthrography
  Descriptions:
  FSN: Magnetic resonance arthrography of X (procedure)
  PT: Magnetic resonance arthrography of X
  Synonym: Magnetic resonance arthrogram of X
  Synonym: Magnetic resonance arthrography of X
  Synonym: MR arthrography of X

6.2.4.8.5 Radionuclide imaging (Nuclear medicine)
Descriptions:
FSN: Radionuclide scan of X (procedure)
PT: Radionuclide scan of X
Synonym: Radioisotope scan of X

Note - Where it is important to represent a particular isotope and associated agents in the concept then the descriptions will be as follows:

Descriptions:
FSN: Radionuclide scan of X using Y (procedure)
PT: Radionuclide scan of X using Y
Synonym: Radioisotope scan of X using Y

6.2.4.8.6 Positron emission tomography
Descriptions:
FSN: Positron emission tomography of X (procedure)
PT: Positron emission tomography of X
Synonym: PET of X

6.2.4.8.7 Single photon emission computed tomography (SPECT)
Descriptions:
FSN: Single photon emission computed tomography of X (procedure)
PT: Single photon emission computed tomography of X
Synonym: SPECT of X

6.2.4.8.8 Fluoroscopy imaging
Note: It was agreed that the use of near synonyms was acceptable for these procedures (ie angiogram/arteriogram).
It was also agreed that the word fluoroscopic was unnecessary in any description other than the FSN.

Unresolved: There was a suggestion that imaging intensifier procedure of X is more correct.

Unresolved: There was a suggestion that GI fluoroscopy needs route of administration and nature of contrast agent identifying. There might also need to be exception to the naming convention, eg barium enema (as opposed to fluoroscopy of colon with barium contrast medium).

Descriptions:
FSN: Fluoroscopy of X (procedure)
PT: Fluoroscopy of X

Note - Simple Fluoroscopy is the real time imaging, usually on TV monitors/image intensifiers, of a body part or system and is only rarely undertaken as an imaging process alone (without use of contrast or some interventional procedure), most commonly fluoroscopy is used to guide or direct the primary procedure or purpose. The convention in clinical practice is largely to ignore the fluoroscopic element and refer to a procedure entirely by the primary component, eg angiography, however this would be unacceptable in SNOMED CT where the imaging component must be explicitly described, at least in the FSN. The convention is to use the adjectival form rather than the noun.

• Fluoroscopic arteriography
  Descriptions:
  FSN: Fluoroscopic arteriography of X (procedure)
  PT: Arteriography of X
  Synonym: Arteriogram of X
  Synonym: Angiography of X
  Synonym: Angiogram of X

• Fluoroscopic venography
  Descriptions:
  FSN: Fluoroscopic venography of X
  PT: Venography of X
  Synonym: Venogram of X

• Fluoroscopic arthrography
  Descriptions:
  FSN: Fluoroscopic arthrography of X (procedure)
  PT: Fluoroscopic arthrography of X
  Synonym: Fluoroscopic arthrogram of X

• Dual energy X-ray photon absorptiometry
  Descriptions:
  FSN: Dual energy X-ray photon absorptiometry of X (procedure)
  PT: Dual energy X-ray photon absorptiometry of X
  Synonym: DXA of X
  Synonym: DEXA of X

6.2.4.8.9 Multiple modality imaging
There are very few imaging procedures which could be truly considered to be multi-modality procedures; on most occasions two procedures can be considered to be conducted in parallel rather than as one. There are, however, a small number of instances where this is the case, and the images are produced by one piece of equipment by (possibly) a single operator, albeit with multiple imaging energies: these are PET/CT and SPECT/CT.
These will be represented as follows:

- Single photon emission computed tomography with computerised tomography
  Descriptions:
  FSN: Single photon emission computed tomography with computerised tomography of \( X \) (procedure)
  PT: Single photon emission computed tomography with computerised tomography of \( X \)
  Synonym: SPECT CT of \( X \)
- Positron emission tomography with computerised tomography
  Descriptions:
  FSN: Positron emission tomography with computerised tomography of \( X \) (procedure)
  PT: Positron emission tomography with computerised tomography of \( X \)
  Synonym: PET CT of \( X \)

6.2.4.8.10 Imaging guided procedures

There are numerous procedures where the imaging component can be considered to be a supplemental or secondary technique to assist with the accomplishment of the primary goal. The primary goal can be either the procedure itself or the imaging guidance, and this difference will be reflected in the pattern of term construction for the fully specified name. In a term that is constructed as "\( Y \) (procedure) using DI Modality guidance", the primary goal is the procedure; but in a term that is constructed as "DI Modality guidance for \( Y \) (procedure)", the primary goal is the guidance.

Where the primary goal is the procedure, and the imaging is secondarily used for guidance, the pattern for all modalities would be:

\[ Y \) (procedure) using DI Modality guidance \]

A synonym should be created that follows the FSN pattern, and in addition a preferred term should be constructed according to the pattern:

\[ DI \) Modality guided \( Y \) (procedure) \]

E.g.

"Biopsy of liver using computed tomography guidance (procedure)" is the FSN, and "CT guided biopsy of liver" is the preferred term.

Specifically, for each ‘guidance’ modality in turn, the patterns are:

- Computed tomography guided procedure
  Descriptions:
  FSN: \( Y \) using computed tomography guidance (procedure)
  PT: CT guided \( Y \)
- Fluoroscopy guided procedure
  Descriptions:
  FSN: \( Y \) using fluoroscopic guidance (procedure)
  PT: Fluoroscopy guided \( Y \)

The term "Fluoroscopic \( Y \)" will be interpreted as meaning "\( Y \) using fluoroscopic guidance (procedure)". Procedures such as | Biopsy of wrist using fluoroscopic guidance (procedure) | will be subtypes of | Fluoroscopy (procedure) |.

- Magnetic resonance imaging guided procedure
  Descriptions:
  FSN: \( Y \) using magnetic resonance imaging guidance (procedure)
  PT: MRI guided \( Y \) (procedure)
- Ultrasonography guided procedure
Descriptions:
FSN: Y using ultrasonographic guidance (procedure)
PT: Ultrasonography guided Y
Syn: Ultrasound guided Y
• X-ray guided procedure
  Descriptions:
  FSN: Y using X-ray guidance (procedure)
  PT: X-ray guided Y

6.2.4.8.11 Contrast for imaging
It is essential to express when contrast is part of a procedure and that descriptions are constructed consistently, for example:
  Descriptions:
  FSN: computerised axial tomography of brain with radiopaque contrast (procedure)
  PT: computerised axial tomography of brain with radiopaque contrast
  CT brain with contrast
  Synonym: CT of brain with contrast
Exceptions to this rule include all fluoroscopic angiography and fluoroscopic guided angiography interventions.
Although vascular contrast and other contrast are regularly used in imaging procedures, it is agreed that there is no need to specify the vascular nature of contrast when this is used, e.g. CT brain with contrast is the accepted pattern, not CT brain with vascular contrast.
It is agreed that it is unnecessary to add the word ‘media’ to make the phrase ‘contrast media’.
It is also agreed that the link word to associate the contrast use with the procedure would be ‘with’, not ‘for’ or anything similar.
There is a case for explicitly adding a term qualification when naming procedures that are explicitly to be performed without contrast. In the UK and Australia, it was reported that there are no procedures that specify “without contrast” pre-coordinated in the national subset and this has the benefit of being able to provide implementation guidance to that effect.
There is also a suggestion that additional term detail is required when it is necessary to know the more precise nature of contrast (e.g. iodinated, with various osmolalities, barium, gaseous).

6.2.4.8.12 Imaging adjustments for view, projection or technique
It can be important both clinically and from an administrative perspective that variations in technique from the norm are captured, not least so that images can be both acquired and interpreted correctly. Examples of modifications include:
• Axial
• Skyline
• Decubitus
• Weight-bearing
• Penetrated
• Stress views
• Soft tissue
• Paediatric
Though these exist as potential qualifying values within SNOMED CT, they are not presently allowable values for post-coordination of DI procedures.
6.2.4.9 Naming conventions for test observable entities

Naming conventions are described for the fully-specified name (FSN) for observable entities, and for naming evaluation procedures or observable entities that are submitted with names from the LOINC or IFCC-IUPAC NPU systems.

6.2.4.9.1 Convention for the FSN for test observable entities:

General naming pattern: Property, Towards, System

• First component: Property
  The property (the | PROPERTY TYPE | of the observable) is named first when possible.
  • Modifier of the first component: Scale Method
    Scale Method refines the Property, and therefore will precede the action in the naming order. (Scale Method, Property)
  • Naming pattern: (Scale Method, Property), Towards, System

• Second component: Towards
  Where possible, the property is named first followed by the entity that is the value of | TOWARDS |.

• Third component: System
  • Modifier of third component: Timing
    Timing provides information about the specimen, and will therefore precede it in the naming order. (Timing, System)

Measurements done by screening should be specified with “by screening method” added at the end of the term

Example:

Level of substance X in Y specimen by screening method

6.2.4.9.2 Guidance for content submitted using LOINC or IFCC-IUPAC names

Naming pattern for LOINC parts: (Scale Method, Action), Analyte, (Timing, Specimen)

Naming pattern for IFCC-IUPAC parts:

• Mandatory terms: System (similar to specimen), Component, Kind-of-property
• Order of terms does not seem to matter due to the multilingual origin and use.

Example: Substance concentration of glucose in blood plasma

Substance concentration (= Kind-of-property) of glucose (= Component) in blood plasma (= System)

Examples of SNOMED CT FSNs for content submitted as LOINC names. For the patterns and the resulting FSNs below, (a) is for the observable, and (b) is for the procedure:

1. Ethylene glycol:MCnc:Pt:Urine:Qn

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Ethylene glycol:MCnc:Pt:Urine:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Ethylene glycol [Mass/volume] in Urine</td>
</tr>
</tbody>
</table>

(a) Pattern: Property X of analyte Y in system Z (observable entity)

(a) FSN: Mass concentration of ethylene glycol in urine (observable entity)

(b) Pattern: Measurement of property X of analyte Y in specimen Z (procedure)

(b) FSN: Measurement of mass concentration of ethylene glycol in urine specimen (procedure)

Comments:
Observables do not necessarily specify the type of specimen obtained for making an observation, but rather may only specify the “system”, in this case the body substance in which the property inheres. It is therefore the default pattern in the observables hierarchy not to mention specimens (they are mentioned when necessary of course). However, it has been the pattern in the procedure axis to name the specimen, and it may be argued that each measurement action necessarily takes place on a specimen. It is therefore the default pattern in the procedure hierarchy to mention specimens.


<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Hemoglobin F:ACnc:Pt:Amnio fld:Ord</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Hemoglobin F [Presence] in Amniotic Fluid</td>
</tr>
</tbody>
</table>

(a) Pattern: Ordinal level of analyte X in system Y (observable)
(a) FSN: Ordinal level of hemoglobin F in amniotic fluid (observable)

(b) Pattern: Ordinal measurement of analyte X in specimen Y (procedure)
(b) FSN: Ordinal measurement of hemoglobin F in amniotic fluid specimen (procedure)

Comments:
Both LOINC and NPU use a property type of arbitrary concentration (ACnc) combined with a scale type of ordinal (Ord) to indicate tests that are reported as either the presence or absence of an entity. Absence/presence is an ordinal scale with only two levels (e.g. absent=0 and present=1), but the combination of ACnc with Ord also allows ordinal scales with more levels (e.g absent=0, small amount=1, large amount=2). As a result, we do not follow the LOINC long common name pattern of calling this [Presence], but instead call it an “ordinal level” (in the observable), and an “ordinal measurement” (in the procedure).

3. Tricyclic antidepressants:MCnc:Pt:Ser/Plas:Qn

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Tricyclic antidepressants:MCnc:Pt:Ser/Plas:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Tricyclic antidepressants [Mass/volume] in Serum or Plasma</td>
</tr>
</tbody>
</table>

(a) Pattern: Property of analyte in system (observable)
(a) FSN: Mass concentration of tricyclic antidepressant in plasma (observable)

(b) Pattern: Measurement of property of analyte in specimen (procedure)
(b) FSN: Measurement of mass concentration of tricyclic antidepressants in serum or plasma specimen (procedure)

Comments:
The names of analytes are given in singular tense. The system is plasma when the specimen is serum or plasma.


<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Creatinine:MRat:24H:Urine:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Creatinine [Mass/time] in 24 hour Urine</td>
</tr>
</tbody>
</table>

(a) Pattern: Rate property X of process Y over duration Z period (observable)
(a) FSN: Mass rate of creatinine excretion in urine over 24 hour period (observable)

(b) Pattern: Measurement of rate property of process Y in duration Z specimen (procedure)
Measurement of mass rate of creatinine excretion in 24 hour urine specimen (procedure)

Comments:
Rates are given per unit time, and describe processes.

5. Creatinine:MCnc:XXX:Urine:Qn

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Creatinine:MCnc:XXX:Urine:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Creatinine [Mass/volume] in unspecified time Urine</td>
</tr>
</tbody>
</table>

(a) Pattern: Property X of analyte Y in specimen Z collected over a time period (observable)
(a) FSN: Mass concentration of creatinine in urine specimen collected over a time period (observable)

(b) Pattern: Measurement of property X of analyte Y in specimen Z collected over a time period (procedure)
(b) FSN: Measurement of mass concentration of creatinine in urine specimen collected over a time period (procedure)

Comments:
Since the property is not a rate, the observable needs to mention the urine specimen and the time period of its collection.

6. Cortisol^6 AM specimen:MCnc:Pt:Ser/Plas:Qn

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Cortisol^6 AM specimen:MCnc:Pt:Ser/Plas:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Cortisol [Mass/volume] in Serum or Plasma --6 AM specimen</td>
</tr>
</tbody>
</table>

(a) Pattern: Property X of analyte Y in system Z at time W (observable)
(a) FSN: Mass concentration of cortisol in plasma at 6 A.M. (observable)

(b) Pattern: Measurement of property X of analyte Y in specimen Z obtained at time W (procedure)
(b) FSN: Measurement of mass concentration of cortisol in serum or plasma specimen obtained at 6 A.M. (procedure)

7. Serum ascites albumin gradient

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Serum ascites albumin gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>? not found in LOINC</td>
</tr>
</tbody>
</table>

(a) Pattern: Analyte X property Y difference between system Z1 and system Z2 (observable)
(a) FSN: Albumin mass concentration difference between serum and peritoneal fluid (observable)

(b) Pattern: Measurement of analyte X property Y difference between system Z1 and system Z2 (procedure)
(b) FSN: Measurement of albumin mass concentration difference between serum specimen and ascitic fluid specimen (procedure)

8. Apolipoprotein A-I/Apolipoprotein B:MCrto:Pt:Ser/Plas:Qn
<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Apolipoprotein A-I/Apolipoprotein B:MCrto:Pt:Ser/Plas:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Apolipoprotein A-I/Apolipoprotein B [Mass ratio] in Serum or Plasma</td>
</tr>
<tr>
<td>(a) Pattern:</td>
<td>Mass ratio of substance X to substance Y in specimen Z (observable)</td>
</tr>
<tr>
<td>(a) FSN:</td>
<td>Mass ratio of apolipoprotein A to apolipoprotein B in plasma (observable)</td>
</tr>
<tr>
<td>(b) Pattern:</td>
<td>Measurement of mass ratio of substance X to substance Y in specimen Z (procedure)</td>
</tr>
<tr>
<td>(b) FSN:</td>
<td>Measurement of mass ratio of apolipoprotein A to apolipoprotein B in serum or plasma specimen (procedure)</td>
</tr>
</tbody>
</table>

9. Amprenavir^peak:MCnc:Pt:Ser/Plas:Qn

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Amprenavir^peak:MCnc:Pt:Ser/Plas:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Amprenavir [Mass/volume] in Serum or Plasma--peak</td>
</tr>
<tr>
<td>(a) Pattern:</td>
<td>Peak property of analyte X in system Y (observable)</td>
</tr>
<tr>
<td>(a) FSN:</td>
<td>Peak mass concentration of amprenavir in plasma (observable)</td>
</tr>
<tr>
<td>(b) Pattern:</td>
<td>Measurement of peak mass concentration of analyte X in specimen Y (procedure)</td>
</tr>
<tr>
<td>(b) FSN:</td>
<td>Measurement of peak mass concentration of amprenavir in serum or plasma specimen (procedure)</td>
</tr>
</tbody>
</table>

10. Amino acids:Imp:Pt:Urine:Nar

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Amino acids:Imp:Pt:Urine:Nar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Amino acids [interpretation] in Urine Narrative</td>
</tr>
<tr>
<td>(a) Pattern:</td>
<td>Pattern of analyte X in system Y (observable)</td>
</tr>
<tr>
<td>(a) FSN:</td>
<td>Pattern of amino acids in urine (observable)</td>
</tr>
<tr>
<td>(b) Pattern:</td>
<td>Interpretation of pattern of analyte X in specimen Y (procedure)</td>
</tr>
<tr>
<td>(b) FSN:</td>
<td>Interpretation of pattern of amino acids in urine (procedure)</td>
</tr>
</tbody>
</table>

Comments:

In this case the pattern necessarily involves multiple amino acids, so singular would not be correct. An observable that is modelled by LOINC with an impression property and a narrative scale type may need creative naming.

11. Lutropin^baseline:MCnc:Pt:Ser/Plas:Qn

<table>
<thead>
<tr>
<th>LOINC name:</th>
<th>Lutropin^baseline:MCnc:Pt:Ser/Plas:Qn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long common name:</td>
<td>Lutropin [Mass/volume] in Serum or Plasma --baseline</td>
</tr>
<tr>
<td>(a) Pattern:</td>
<td>Property X of analyte Y in baseline specimen Z (observable)</td>
</tr>
<tr>
<td>(a) FSN:</td>
<td>Mass concentration of lutropin in baseline plasma (observable)</td>
</tr>
<tr>
<td>(b) Pattern:</td>
<td>Measurement of property X of analyte Y in baseline specimen Z (procedure)</td>
</tr>
<tr>
<td>(b) FSN:</td>
<td>Measurement of mass concentration of lutropin in baseline serum or plasma specimen (procedure)</td>
</tr>
</tbody>
</table>

| LOINC name: | Erythrocyte Ab:ACnc:Pt:Ser:Qn |
| Long common name: | Erythrocyte Ab [Units/volume] in Serum |

(a) Pattern: Property of analyte X in system Y (observable)
(a) FSN: Concentration of erythrocyte antibody in plasma (observable)

(b) Pattern: Measurement of concentration of analyte X in specimen Y (procedure)
(b) FSN: Measurement of concentration of erythrocyte antibody in serum specimen (procedure)

Comments:
In the case of red cell antibodies, serum is routinely used, but the system is still plasma. When the LOINC property type is ACnc and the scale type is Qn, we use only the word “concentration”, rather than spelling out “arbitrary concentration”.

6.2.4.10 Naming conventions for techniques

Techniques will include the word “technique” in their FSN; for example, "Microbial culture technique (qualifier value)".

6.2.4.11 Naming conventions for substances

- **Ribosomal ribonucleic acid of X organism**
  
  FSN: |Ribosomal ribonucleic acid of X organism (substance)|
  
  Preferred Term (US/GB), with Initial letter case sensitive: |X organism rRNA|
  
  Synonyms: A synonym that matches FSN
  
  Parent concept: Most distal appropriate descendant of 118251005 | Microbial ribosomal ribonucleic acid (substance)
  
  Example:
  
  FSN: Ribosomal ribonucleic acid of Candida (substance)
  Preferred Term, with Initial letter case sensitive: Candida rRNA
  Synonym: Ribosomal ribonucleic acid of Candida
  Parent concept: Microbial ribosomal ribonucleic acid (substance)

- **Ribonucleic acid of X organism**
  
  FSN: |Ribonucleic acid of X organism (substance)|
  
  Preferred Term (US/GB), with Initial letter case sensitive: |X organism RNA|
  
  Synonyms: A synonym that matches FSN
  
  Parent concept: Most distal appropriate descendant of 118248003|Microbial ribonucleic acid (substance)
  
  Example:
  
  FSN: Ribonucleic acid of Norovirus genogroup I (substance)
  Preferred Term, with Initial letter case sensitive: Norovirus genogroup I RNA
  Synonym: Ribonucleic acid of Norovirus genogroup I
  Parent concept: Microbial ribonucleic acid of Norovirus genogroup I

- **Deoxyribonucleic acid of X organism**
  
  FSN: |Deoxyribonucleic acid of X organism (substance)|
  
  Preferred Term (US/GB), with Initial letter case sensitive: |X organism DNA|
Synonyms: A synonym that matches FSN
Parent concept: Most distal appropriate descendant of [118249006]Microbial deoxyribonucleic acid (substance)]

Example:
FSN: Deoxyribonucleic acid of Aspergillus terreus (substance)
Preferred Term, with Initial letter case sensitive: Aspergillus terreus DNA
Synonym: Deoxyribonucleic acid of Aspergillus terreus
Parent concept: Deoxyribonucleic acid of Aspergillus (substance)

- **Antigen of X organism**
  
  FSN: [Antigen of X organism (substance)]
  Preferred Term (US/GB), with Initial letter case sensitive: |X organism Ag|
  Synonyms: A synonym that matches FSN
  Synonyms with Initial letter case sensitive: |X organism antigen|
  Parent concept: Most distal appropriate descendant of |116633006|Microbial antigen (substance)]

- **Antibody to X organism**
  
  FSN: [Antibody to X organism (substance)]
  Preferred Term (US/GB), with Initial letter case sensitive: |X organism Ab|
  Synonyms: A synonym that matches FSN
  Synonyms: Anti-X antibody
  Synonyms with Initial letter case sensitive: |X organism antibody|
  Parent concept: Most distal appropriate descendant of |116642004|Antimicrobial antibody (substance)]

- **Immunoglobulin G, M, A, E, D antibody to X organism**
  
  FSN: [Immunoglobulin G, M, A, E, D antibody to X organism (substance)]
  Preferred Term (US/GB), with Initial letter case sensitive: |X organism IgG, M, A, E, D |
  Synonyms: A synonym that matches FSN
  Synonyms: Anti-X organism IgG, M, A, E, D
  Parent concept: Most distal appropriate descendant of [399812006]Antibody class (substance)]
  Parent concept: |X species antibody (substance)| if in SNOMED CT

- Descriptions, including FSNs, Preferred terms, and/or Synonyms, in the Substance hierarchy should not contain the word "total". Terms containing the word "total" (e.g. "total cholesterol") should not be added to the Substance hierarchy. Existing terms were retired as part of the January 2015 SNOMED CT release due to the inability to differentiate the definition between the "base" substance and "total" substance (e.g. "cholesterol" versus "total cholesterol") within the context of the Substance hierarchy as well as the inability to create an appropriate relationship between the "base" and "total" concepts.

### 6.2.4.11.1 Naming conventions for antivenom

Antivenin and antivenom concepts in the Substance Hierarchy should be descendants of |Antivenin (substance)|. No new sub-grouper concepts should be added until further notice. The value of and need for sub-grouper concepts will be evaluated as part of the Substance Hierarchy Redesign Project.

Use antivenom, not antivenin, for FSNs and Preferred Terms. Synonyms containing antivenin will not be created routinely, but may be created upon request. Existing concepts that are not consistent with this naming convention will be cleaned up as a batch at a later date.

FSNs should be based on the scientific name, if there is a one-to-one correspondence. Naming conventions for polyvalent antivenoms (effective against multiple organisms) will not comply with this naming convention, and will be evaluated on a case-by-case basis. Preferred Terms should be based on the common name. Synonyms based on the scientific name should be created in most cases.
Useful reference: Current version of “WHO Guidelines for the Production, Control and Regulation of Snake Antivenom Immunoglobulins”.

6.2.4.12 Naming conventions for pharmaceuticals and biologic products
6.2.4.12.1 Acronyms and Notations

Table 186: Table of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BoSS</td>
<td>Basis Of Strength Substance</td>
</tr>
<tr>
<td>EBNF</td>
<td>Extended Backus-Naur</td>
</tr>
<tr>
<td>FSN</td>
<td>Fully Specified Name</td>
</tr>
<tr>
<td>ID</td>
<td>Identifier</td>
</tr>
<tr>
<td>INN</td>
<td>International Non-proprietary Name</td>
</tr>
<tr>
<td>mINN</td>
<td>Modified International Non proprietary Name</td>
</tr>
<tr>
<td>ME</td>
<td>Medicinal Entity</td>
</tr>
<tr>
<td>NPMP</td>
<td>Non Proprietary Medicinal Preparation</td>
</tr>
<tr>
<td>PT</td>
<td>Preferred Term</td>
</tr>
<tr>
<td>RF2</td>
<td>SNOMED CT Release Format 2</td>
</tr>
<tr>
<td>SNOMED CT®</td>
<td>SNOMED Clinical Terms</td>
</tr>
</tbody>
</table>

Notation:
The definitions are written using a notation for describing formal languages, called Extended Backus-Naur Form (EBNF). EBNF has been standardised by the ISO under the code ISO/IEC 14977:1996(E), and this document uses the following characters:

<table>
<thead>
<tr>
<th>Character</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>;</td>
<td>Terminating character</td>
<td>This identifies the end of a rule (called a “production rule”).</td>
</tr>
<tr>
<td>[ ... ]</td>
<td>Option</td>
<td>Encloses optional items</td>
</tr>
<tr>
<td>{ ... }</td>
<td>Optional repetition</td>
<td>Encloses optional items that can be repeated zero or more times.</td>
</tr>
<tr>
<td>( ... )</td>
<td>Arrangement in groups</td>
<td>Encloses items that need to be grouped together.</td>
</tr>
<tr>
<td>“ ... ”</td>
<td>Double quotation</td>
<td>A terminal expression (i.e. characters that appear exactly as shown).</td>
</tr>
</tbody>
</table>
6.2.4.12.2 General Style Rules

This document deals with rules that are used to describe concepts within the SNOMED CT® International release. The SNOMED CT® International release does not describe branded products, differing container sizes of a medicine, unit dose types or medicines presented as multicomponent packs. These will be part of a national extension where required and it is seen as the responsibility of the National Extension to map to the correct SNOMED CT® International release concept.

Other than those attributes used in the model for medicinal products it is assumed that all other attributes will be retired to avoid confusion.

It is anticipated that the terms required to describe concepts for use in interface systems may need to be created at the national level as national Preferred Terms [1]; therefore use of the International Release Preferred Term may occur to give an indication of how a term may be described within the national extension or to be used to assist translation.

Not all concepts in the model are defined: for example qualifier Relationships and data representation concepts; these are assumed to have standard SNOMED CT® definitions.

The following rules apply to all names below:

- Names will not include commas
- “mL” – will include a uppercase L to be consistent with the abbreviation for litre “L”
- Representation of per one mL will be “/mL” rather than “/1mL”
- A space will be placed in front of an opening parenthesis and after a closing parenthesis (unless it is at the end of the product’s name), but not within parentheses e.g. aaaa (bbbb) cccc.
- Where a name includes a + symbol a space will be placed either side of the plus symbol e.g. ibuprofen + oxycodone (product)
- Ratio representations will use a colon for the FSN and the PT
- Where a name includes the word “pre-filled” change to prefilled
- All strength representations with microgram or nanogram as the unit of strength should be written out in full.
- The units used in strength representation should be singular e.g. unit, microgram, mg, mL
- All names which include the term product or preparation other than as part of the semantic tag will be retired and the new name will not include product or preparation. E.g. formaldehyde product (product) to formaldehyde (product);
  acetylcholine preparation (product) to acetylcholine (product)
- Capitalisation will only exist when significant as defined in the section Capitalization of Pharmaceuticals and Biologic Products on page 394. E.g. ibuprofen + oxycodone not Ibuprofen + Oxycodone

[1] RF2 will no longer contain a Description type value “Preferred Term”, only types of “Fully Specified Name” and “Synonym”, Synonyms may be refined either to “Preferred” or “Acceptable” using the acceptability attribute within a language reference set. As a result of this change in RF2 the preference for particular Descriptions in a language or dialect but it will be represented using a reference set.

6.2.4.12.3 Medicinal Entity (ME) Editorial Rules

6.2.4.12.3.1 Medicinal Entity Definition

A Medicinal Entity (ME) is the abstract representation of the set of active ingredient(s) (devoid of strength and form), which when formulated as a medicinal product, is intended for use in the treatment of a patient by at least one member nation. i.e. a NPMP must exist somewhere internationally. Where a member nation requests the addition of an ME concept that is within the scope of the Pharmaceutical and Biological product hierarchy, as defined in the Boundary and Scope standard, it will be added to the International release.

The medicinal entity class is recursive: an instance medicinal entity can have a child instance of a related medicinal entity to support the Relationship between a “moiety” medicinal entity and a “moiety with modifier” medicinal entity (e.g. two medicinal entities representing the moiety and the moiety + modifier).

Note that the Medicinal Entity Name is derived from the active ingredient of substance concepts, with the following knowledge or rules incorporated:

- The active moiety or the moiety with modifier is specified.
· A Medicinal Entity defines a group of products as represented by a set of one or more NPMPs, which contain substances with the same combination of active moieties.

· Medicinal Entities concepts will have a Relationship to all of their active ingredients, using one or more “has intended active ingredient” Relationship(s).

· Multicomponent packs are out of scope of the International release and so Medicinal Entity concepts will not be created to represent the components of such packs. However it is noted that the International Release must represent the individual active components of these packs and Medicinal Entity concepts will be provided to support this.

· Where there is a Medicinal Entity that is a moiety with modifier a corresponding moiety concept will be created.

· Some circumstances (for example when it is a multi-ingredient product) require more than two levels to the hierarchy may be required

---

### 6.2.4.12.3.2 Medicinal Entity Descriptions

#### 6.2.4.12.3.2.1 Medicinal Entity "Fully Specified Name" Definition

The default FSN of Medicinal Entities can be defined as follows:

\[
\text{ME FSN: = (Ingredient_Details) "(product)"}
\]

<table>
<thead>
<tr>
<th>Description of Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicinal Entity FSN</td>
<td>(Ingredient_Details) &quot; (product)&quot;</td>
</tr>
<tr>
<td>Ingredient_Details</td>
<td>Ingredient_Name { &quot; + &quot; Ingredient_Name }</td>
</tr>
<tr>
<td></td>
<td>1. An Ingredient_Name is included for each ingredient in the given Medicinal Entity.</td>
</tr>
<tr>
<td></td>
<td>2. Ingredient_Name are ordered alphabetically within each Medicinal Entity.</td>
</tr>
<tr>
<td>Ingredient_Name</td>
<td>Ingredient_Name { &quot; + &quot; Ingredient_Name}</td>
</tr>
<tr>
<td></td>
<td>1. One Ingredient_Name is included for each ‘ME has active Ingredient’ Relationship.</td>
</tr>
<tr>
<td></td>
<td>2. The Ingredient_Name are ordered alphabetically based on the Preferred Term where ME has active Ingredient.</td>
</tr>
<tr>
<td></td>
<td>3. The name for different ingredients are separated by a &quot; + &quot;.</td>
</tr>
<tr>
<td>(product)</td>
<td>The semantic tag used in the FSN of all Medicinal Entity concepts.</td>
</tr>
</tbody>
</table>

#### 6.2.4.12.3.2.2 Medicinal Entity "Fully Specified Name" Rules

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEFSNI</td>
<td>All rules in FSN Definition and Rules apply. Capitalisation rules apply, as defined in Capitalization of Pharmaceuticals and Biologic Products on page 394.</td>
</tr>
<tr>
<td>MEFSN2</td>
<td>The Medicinal Entity FSN will be derived from the INN if active ingredient is a “moiety” or mINN if active ingredient is a “moiety with modifier”. Where an International name is not available from The World Health Organisation, national pharmaceutical naming conventions should be used e.g. USAN or BAN to derive the Medicinal Entity FSN.</td>
</tr>
</tbody>
</table>
6.2.4.12.3.2.3 Medicinal Entity "Preferred Term" Definition

The default SNOMED CT® International Release Preferred Term of a Medicinal Entity can be more fully defined as follows:

**ME PT: = (Ingredient_Details)**

<table>
<thead>
<tr>
<th>Description Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicinal Entity PT</td>
<td>(Ingredient_Details)</td>
</tr>
<tr>
<td>Ingredient_Details</td>
<td>Ingredient_Name { &quot; + &quot; Ingredient_Name }</td>
</tr>
<tr>
<td></td>
<td>1. An Ingredient_Name is included for each ingredient in the given Medicinal Entity.</td>
</tr>
<tr>
<td></td>
<td>2. Ingredient_Names are ordered alphabetically within each Medicinal Entity.</td>
</tr>
<tr>
<td>Ingredient_Name</td>
<td>ME has active ingredient Preferred Term where ME has Ingredient.</td>
</tr>
</tbody>
</table>

6.2.4.12.3.2.4 Medicinal Entity "Preferred Term" Rules

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-PR1</td>
<td>All rules defined in Preferred Term Definition and Rules apply. Capitalisation rules apply, as defined in Capitalization of Pharmaceuticals and Biologic Products on page 394.</td>
</tr>
<tr>
<td>ME-PT2</td>
<td>The Medicinal Entity PT will be derived from the INN if active ingredient is a “moiety”, or mINN if active ingredient is a “moiety with modifier”. Where an International name is not available from The World Health Organisation, national pharmaceutical naming conventions should be used e.g. USAN or BAN to derive the Medicinal Entity PT.</td>
</tr>
<tr>
<td>ME-PT3</td>
<td>The sequence of ingredients in the Medicinal Entity Preferred Term will, by default, be based on the alphabetic order of the ingredient names. EXCEPTION: currently no exceptions exist. NOTE National releases may choose a different order or term where local clinical practise justifies this, for example: ticarcillin + clavulanic acid.</td>
</tr>
</tbody>
</table>

6.2.4.12.3.2.5 Examples of Medicinal Entity Terms

<table>
<thead>
<tr>
<th>Type of product</th>
<th>ME Fully Specified Name</th>
<th>ME Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Ingredient- moiety</td>
<td>amoxicillin (product)</td>
<td>amoxicillin</td>
</tr>
<tr>
<td>Type of product</td>
<td>ME Fully Specified Name</td>
<td>ME Preferred Term</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Single Ingredient – moiety with modifier</td>
<td>haloperidol decanoate (product)</td>
<td>haloperidol decanoate</td>
</tr>
<tr>
<td>Multi-Ingredient – moiety</td>
<td>codeine + paracetamol (product)</td>
<td>codeine + paracetamol</td>
</tr>
<tr>
<td>Multi-Ingredient – “moiety” and moiety with modifier</td>
<td>codeine phosphate + paracetamol (product)</td>
<td>codeine phosphate + paracetamol</td>
</tr>
</tbody>
</table>

### 6.2.4.12.4 Non Proprietary Medicinal Preparation (NPMP) Editorial Rules

#### 6.2.4.12.4.1 Non Proprietary Medicinal Preparation Definition

A Non Proprietary Medicinal Preparation (NPMP) is an abstract concept representing the properties of one or more clinically equivalent Proprietary Product Unit of Uses (from existing or past) National extensions.

A NPMP is the abstract representation of the set of active ingredient(s) and their strength(s) and dose form. Where strength is a ratio (concentration) example 500 mg per unit dose for discrete dosage forms or 50 mg/mL for continuous dosage forms, strength is represented at a single unit level e.g. per mL or per g.

A new NPMP will be created for each different strength and dosage form of a licenced medicinal product. If an existing product has a change of ingredient, such that it does not conform to the ingredients of the original NPMP, then a new NPMP will be created for the new product.

#### 6.2.4.12.4.2 Non Proprietary Medicinal Preparation Descriptions

### 6.2.4.12.4.2.1 Non Proprietary Medicinal Preparation "Fully Specified Name" Full Definition

The **Fully Specified Name** of a Non Proprietary Medicinal Preparation can be more fully defined as follows:

\[
\text{NPMP FSN: } = (\text{Ingredients} \_\text{With} \_\text{Strength}) \_ " \_ \text{Form} \_ " \_ (\text{product})
\]

<table>
<thead>
<tr>
<th>Description Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Proprietary Medicinal Preparation FSN</td>
<td>(Ingredients_With_Strength) _ &quot; _ Form _ &quot; _ (product)</td>
</tr>
<tr>
<td>Ingredients_With_Strength</td>
<td>Ingredient_Strength _ (&quot; + &quot; _ Ingredient_Strength)</td>
</tr>
<tr>
<td></td>
<td>1. One Ingredient_Strength is included for each ME _has active ingredient_ Relationship that exists on the parent ME.</td>
</tr>
<tr>
<td></td>
<td>2. The Ingredient_Strengths are ordered alphabetically based on the Preferred Term of the NPMP_s reference BoSS (followed by the Preferred Term of the associated ME_s active ingredient). The ingredient-strength pairs are separated from each other by a &quot; + &quot;.</td>
</tr>
</tbody>
</table>
### Ingredient_Strength

If the parent ME’s ‘has active ingredient’ Relationship has an associated ‘has reference BoSS’ Relationship on the NPMP:

BoSS [“ (as " Active Ingredient “) ” “ Strength
where BoSS is the PT of the Ingredient from the Relationship ‘NPMP has reference BoSS’ and Strength is the strength associated with this Relationship.

The Active_Ingredient is the PT of the Ingredient from the Relationship ‘ME has active ingredient’ on the NPMP’s parent ME. The “ (as " Active_Ingredient “) ” is only included where the BoSS is different from the Active_Ingredient.

If the parent ME’s ‘has active ingredient’ Relationship is not grouped to any ‘has reference’ Relationship on the NPMP:

Active Ingredient “ ” Strength
where Active Ingredient is the PT of the Ingredient from the Relationship ‘ME has active ingredient’ on the NPMP’s parent ME.

### Form

The dose formulation of the NPMP, defined in a non-proprietary way. This is the PT of the Form (F) from the Relationship ‘NPMP has dose form F’.

### (product)

The semantic tag used in the FSN of all Non Proprietary Medicinal Preparation concepts.

---

#### 6.2.4.12.4.2.2 Non Proprietary Medicinal Preparation "Fully Specified Name" Rules

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPMPFN1</td>
<td>All rules in FSN Definition and Rules apply. Capitalisation rules apply, as defined in Capitalization of Pharmaceuticals and Biologic Products on page 394.</td>
</tr>
<tr>
<td>NPMPFN2</td>
<td>The Non Proprietary Medicinal Preparation will be derived from the “moiety” or “moiety with modifier” of the BoSS, as defined for NPMP FSN.</td>
</tr>
</tbody>
</table>
| NPMPFN3 | Strength expression:
All NPMP FSN will include strength expression (if available). The strength expression general rules and application to specific medication forms is outlined in General Strength Formats on page 396.
There are occasions when expression of strength is not appropriate, e.g. Aqueous cream. Exceptions list will be reviewed on a case by case basis. See EXCEPTIONS that do not require a strength to be specified on page 399. |
| NPMPFN4 | The form will be expressed as a singular form, e.g. tablet, capsule |

#### 6.2.4.12.4.2.3 Non Proprietary Medicinal Preparation "Preferred Term" Definition

The default SNOMED CT® International Release Preferred Term of a Non Proprietary Medicinal Preparation can be defined as follows:

\[ NPMP\ PT:\ = (Ingredients\ _With\ _Strength) \ " \ " Form \]
### Description Component

<table>
<thead>
<tr>
<th>Description Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Proprietary Medicinal Preparation PT</td>
<td>(Ingredients_With_Strength) “ &quot; Form</td>
</tr>
<tr>
<td>Ingredients_With_Strength</td>
<td>Ingredient_Strength { “ + “ Ingredient_Strength}</td>
</tr>
<tr>
<td></td>
<td>1. One Ingredient_Strength is included for each ‘ME has active ingredient’ Relationship that exists on the parent ME.</td>
</tr>
<tr>
<td></td>
<td>2. The Ingredient_Strengths are ordered alphabetically based on the Preferred Term of the NPMP's reference BoSS (followed by the Preferred Term of the associated ME's active ingredient).</td>
</tr>
<tr>
<td></td>
<td>3. The ingredient-strength pairs are separated from each other by a “ + “.</td>
</tr>
<tr>
<td>Ingredient_Strength</td>
<td>If the parent ME’s ‘has active ingredient’ has an associated strength then:</td>
</tr>
<tr>
<td></td>
<td>BoSS [ “ (as &quot; Active_Ingredient_Minus_BoSS “) ] “ “ Strength</td>
</tr>
<tr>
<td></td>
<td>where BoSS is the PT of the Ingredient from the Relationship ‘NPMP has reference BoSS’ and Strength is the strength associated with this Relationship.</td>
</tr>
<tr>
<td></td>
<td>The Active_Ingredient_Minus_BoSS is the PT of the Ingredient from the Relationship ‘ME has active ingredient’ on the NPMP’s parent ME, except with the PT of the BoSS removed from this string (if it is present in full). The “ (as &quot; Active_Ingredient_Minus_BoSS “) “ is only included where the BoSS is different to the Active_Ingredient.</td>
</tr>
<tr>
<td></td>
<td>If the parent ME’s ‘has active ingredient’ Relationship does not have an associated strength then:</td>
</tr>
<tr>
<td></td>
<td>Active Ingredient “ “ Strength</td>
</tr>
<tr>
<td></td>
<td>where Active Ingredient is the PT of the Ingredient from the Relationship ‘ME has active ingredient’ on the NPMP’s parent ME.</td>
</tr>
<tr>
<td>Form</td>
<td>The dose formulation of the NPMP, defined in a non-proprietary way. This is the PT of the Form (F) from the Relationship ‘NPMP has dose form F’.</td>
</tr>
<tr>
<td></td>
<td>NPMP has dose form.PT</td>
</tr>
</tbody>
</table>

### 6.2.4.12.4.2.4 Non Proprietary Medicinal Preparation "Preferred Term" Rules

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPMPPT1</td>
<td>All rules defined in Preferred Term definition and rules apply. Capitalisation rules apply, as defined in Capitalization of Pharmaceuticals and Biologic Products on page 394.</td>
</tr>
<tr>
<td>NPMPPT2</td>
<td>The Non Proprietary Medicinal Preparation will be derived from the “moiety” or “moiety with modifier” of the BoSS, as defined for NPMP PT.</td>
</tr>
<tr>
<td>NPMPPT3</td>
<td>Where the associated active ingredient is different from the BoSS (e.g. it may be a modification of the BoSS), then the name of the active ingredient (with the BoSS name removed if present in full) is included in brackets following the word “as” in the NPMP's Preferred Term.</td>
</tr>
<tr>
<td></td>
<td>e.g. Erythromycin (as ethylsuccinate) 500 mg tablet</td>
</tr>
<tr>
<td></td>
<td>e.g. Clavulanic Acid (as Potassium Clavulanate) 125 mg tablet</td>
</tr>
<tr>
<td></td>
<td>e.g. Diclofenac Sodium (as Diclofenac Diethylammonium) 10 mg/g Gel</td>
</tr>
</tbody>
</table>
**Rule ID** | **Description**
--- | ---
NPMP-PT4 | Strength expression
All NPMP PT will include a strength expression (if available). The strength expression general rules and application to specific medication forms is outlined in General Strength Formats on page 396.
There are occasions when expression of strength is not appropriate. e.g. Aqueous cream, coal tar, glucose powder. Exceptions list will be reviewed on a case by case basis. See EXCEPTIONS that do not require a strength to be specified on page 399.

NPMP-PT5 | The form will be expressed as a singular form, e.g. tablet, ampoule.

### 6.2.4.12.4.2.5 Examples of Non Proprietary Medicinal Preparation Terms

<table>
<thead>
<tr>
<th>Type of Product</th>
<th>Fully Specified Name</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single ingredient product - (moiety)</td>
<td>amoxicillin 500 mg capsule (product)</td>
<td>amoxicillin 500 mg capsule</td>
</tr>
<tr>
<td>Single ingredient product (moiety and moiety with modifier)</td>
<td>diclofenac 46.54 mg tablet (product)</td>
<td>diclofenac 46.54 mg tablet</td>
</tr>
<tr>
<td></td>
<td>diclofenac sodium 50 mg tablet (product)</td>
<td>diclofenac sodium 50 mg tablet</td>
</tr>
<tr>
<td>Multi-Ingredient (moiety and moiety with modifier as BoSS)</td>
<td>codeine 23.43 mg + paracetamol 500 mg tablet (product)</td>
<td>codeine 23.43 mg + paracetamol 500 mg tablet</td>
</tr>
<tr>
<td></td>
<td>codeine phosphate 30 mg + paracetamol 500 mg tablet (product)</td>
<td>codeine phosphate 30 mg + paracetamol 500 mg tablet</td>
</tr>
<tr>
<td>Single ingredient product (moiety and moiety with modifier)</td>
<td>fluphenazine 9.24 mg/mL solution for injection (product)</td>
<td>fluphenazine 9.24 mg/mL solution for injection</td>
</tr>
<tr>
<td></td>
<td>fluphenazine decanoate 12.5 mg/mL solution for injection (product)</td>
<td>fluphenazine decanoate 12.5 mg/mL solution for injection</td>
</tr>
</tbody>
</table>

### 6.2.4.12.5 Capitalization of Pharmaceuticals and Biologic Products

The first character of a Description will either be lowercase or an integer unless listed as exception.
6.2.4.12.5.1 Capitalization of amino acid isomers

The isomeric prefix D or L will be indicated using a capital letter. The name of the entity itself will be entirely in lower case if prefixed by anything other than a number. Where a name is broken up using descriptors the entity names are in lower case.

- N-acetyl
- 2-methyl
- N-acetyl-L-cysteine
- Note: L-lysine will only be lysine as D-Lysine is not available

6.2.4.12.6 Ingredient/Basis of Strength Substance Naming Conventions

Note: Ingredient and Basis of Strength Substance names will be derived from the INN and Martindale: The Complete Drug Reference unless listed as an exception.

Ingredient and Basis of Strength Substance that end in “ate” when available as a salt shall be changed so that the moiety is represented by ending in “ic acid” where appropriate so as to match the WHO International Non-proprietary Names.

Additional examples will be added when required.

Examples:

<table>
<thead>
<tr>
<th>Name</th>
<th>INN Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>alendronate</td>
<td>alendronic acid</td>
</tr>
<tr>
<td>clodronate</td>
<td>clodronic acid</td>
</tr>
<tr>
<td>cromoglycate</td>
<td>cromoglycic acid</td>
</tr>
<tr>
<td>etidronate</td>
<td>etidronic acid</td>
</tr>
<tr>
<td>folate</td>
<td>folic acid</td>
</tr>
<tr>
<td>folinate</td>
<td>folinic acid</td>
</tr>
<tr>
<td>fusidate</td>
<td>fusidic acid</td>
</tr>
<tr>
<td>mycophenolate</td>
<td>mycophenolic acid</td>
</tr>
<tr>
<td>pamidronate</td>
<td>pamidronic acid</td>
</tr>
<tr>
<td>risedronate</td>
<td>risedronic acid</td>
</tr>
<tr>
<td>tiludronate</td>
<td>tiludronic acid</td>
</tr>
<tr>
<td>valproate</td>
<td>valproic acid</td>
</tr>
</tbody>
</table>

Ingredient and Basis of Strength Substance shall have the order of their name changed where necessary, so that the clinically significant part of the salt name is represented first.

Examples:
<table>
<thead>
<tr>
<th>Name</th>
<th>SNOMED CT® International Release Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>calcium folinate</td>
<td>folinate calcium</td>
</tr>
<tr>
<td>disodium etidronate</td>
<td>etidronate disodium</td>
</tr>
<tr>
<td>disodium pamidronate</td>
<td>pamidronate disodium</td>
</tr>
<tr>
<td>potassium clavulanate</td>
<td>clavulanate potassium</td>
</tr>
<tr>
<td>sodium citrate</td>
<td>citrate sodium</td>
</tr>
<tr>
<td>disodium clodronate</td>
<td>clodronate disodium</td>
</tr>
<tr>
<td>sodium cromoglicate</td>
<td>cromoglicate sodium</td>
</tr>
<tr>
<td>sodium fusidate</td>
<td>fusidate sodium</td>
</tr>
<tr>
<td>sodium valproate</td>
<td>valproate sodium</td>
</tr>
</tbody>
</table>

6.2.4.12.6.1 Waters of Hydration

Waters of hydration shall be expressed for each ingredient where hydration is clinically significant. Where an ingredient or BoSS is found to be anhydrous, this shall not be expressed.

6.2.4.12.6.2 Insulins

The name for insulins will be modified to show the type of insulin for discussion:

- insulin aspart
- insulin aspart protamine
- insulin detemir
- insulin glargine
- insulin glulisine
- insulin lispro
- insulin lispro protamine
- isophane insulin bovine
- isophane insulin human
- neutral insulin bovine
- neutral insulin human

6.2.4.12.7 General Strength Formats

6.2.4.12.7.1 General Rules

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP-STR-1</td>
<td>The strength units will be consistent with the Unit of Measure reference set</td>
</tr>
<tr>
<td>APP-STR-2</td>
<td>Note that any overage contained in the product to allow the formulated amount to be administered is not specified.</td>
</tr>
</tbody>
</table>
### Rule ID  Description

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP-STR-3</td>
<td>In general, the strength of a BoSS should be expressed by a number between 1 and 999 metric units. That is, if the number of units is less than 1 (for example 0.5), the next lower unit level should be used (e.g. 500 microgram should be used in preference to 0.5 mg). If the value is equal to or greater than 1000 milligram (“mg”), convert to and display as gram (“g”). If the value is less than 1 milligram (“mg”) convert to and display as microgram. If the value is equal to or greater than 1000 millilitre (“mL”), convert to and display as litre (“L”). Note: for large volume parenteral injections, irrigation solutions, haemodialysis and peritoneal dialysis solutions, display as millilitres (“mL”). Where the strength unit of measure will vary for the actual ingredient, BoSS and base ingredient according to this rule, all units of measure for the substance will standardised according to the unit of measure for the BoSS.</td>
</tr>
<tr>
<td>APP-STR-4</td>
<td>A space will be inserted between the strength value and strength unit of measure.</td>
</tr>
<tr>
<td>APP-STR-5</td>
<td>The full term “unit” will be used rather than the abbreviated “U”.</td>
</tr>
<tr>
<td>APP-STR-6</td>
<td>The percentage strength will be qualified with the appropriate w/w or w/v.</td>
</tr>
</tbody>
</table>

6.2.4.12.7.2 *Strength Expression Rules*

The rules for the expression of strength to be used for various dose forms is as follows. For safety reasons, Member Nations may require items to have an alternate representation of the strength or dual representation of strength. This will be achieved by the use of a synonym contained in the National release.

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP-STR-7</td>
<td>The strength is expressed per one each (e.g. x mg per one mL, not per &lt; 1 or &gt; 1 mL)</td>
</tr>
<tr>
<td>APP-STR-8</td>
<td>Unit dose form, solid and liquid: the strength is expressed per unit dose. The package type is not identifying for the concept, and should be managed by the National release if required to be identified. If there are different package types, the concept is the same. Unit dose means that each package contains the amount intended to be taken as a single measured dose. Medicinal products in a packages intended for single use but that are not completely administered as a dose (e.g. Minims and ampoules) are handled as continuous dose forms.</td>
</tr>
<tr>
<td>APP-STR-9</td>
<td>Continuous dose forms, (semi)solid and liquid: the strength is expressed per gram or per mL. The size of the package (vial 10 mL or 100 mL) is not defining for the concept and should be managed by the National release. If the package size of two products is different, but the reference BoSS, strength and dosage form are the same, then the concept associated with those two products is the same.</td>
</tr>
<tr>
<td>APP-STR-10</td>
<td>Nasal/respiratory/sublingual products that are used per dose: the strength is expressed per dose.</td>
</tr>
<tr>
<td>APP-STR-11</td>
<td>Where delivered dose and metered dose differ (e.g. for some metered dose inhalers) strength should be expressed as the metered dose.</td>
</tr>
</tbody>
</table>
### Rule ID | Description
---|---
**APP-STR-12** | Patches: the strength is expressed as the amount delivered per unit of time. The time duration over which the patch is intended to be used (e.g. 3 days or a week) is not defining for the concept and should be managed by the National release; if the Patch duration is different, the concept is the same.

**APP-STR-13** | Where strength is commonly expressed as a percentage, for example in case of certain eye drops and saline. This would be added as a synonym in the SNOMED CT® International Release with the FSN being defined as above.

### Medication Form | Rules
---|---
Solid unit dose forms – tablets, capsules, pessaries, suppositories, urethral stick, lozenge, pastille, chewing gum, granules or powder in a package for unit dose | Strength is to be expressed as the amount per unit dose, for example: amoxicillin 500 mg capsulefentanyl 400 microgram lozengemesalazine 500 mg modified release granules per unit dose

Liquid unit dose forms – liquids in a package for unit dose | lactulose 10 g syrup per unit dosesalbutamol 2.5mg solution for nebulisation unit dose

Solid continuous dose forms – granules, powders | psyllium husk 535 mg/g powder

Semi solid continuous dose forms – creams, gels, ointments | aciclovir 50 mg/g cream

Strength is to be expressed as amount per unit.

Liquid continuous dose forms | timolol 10 mg/mL eye drops
xylometazoline 1 mg/mL nasal drops
ipratropium bromide 500 microgram/mL solution for inhalation

Liquid parenteral dose forms | Will always be considered as continuous dose forms rather than unit doses where there is a known concentration per volume.
e.g. furosemide 10 mg/mL solution for injection
carboplatin 10 mg/mL solution for injection
insulin 100 international units/mL solution for injection

Patches | estradiol 4.17 microgram/hour patch

Powder for suspension, oral | amoxicillin 50 mg/mL oral suspension

Powder for solution, parenteral | amoxicillin 500 mg powder for injection

Nasal/respiratory/sublingual sprays/powder – metered dose inhalers, pressurised inhalers, dry powders, nasal/sublingual sprays | salbutamol 100 microgram/dose powder for inhalation
salbutamol 100 microgram/metered dose pressurised inhalation
6.2.4.12.7.3 EXCEPTIONS that do not require a strength to be specified

There are occasions when expression of strength is not appropriate. An exceptions list will be reviewed on a case by case basis.

Examples:
Aqueous cream
Calamine lotion

6.2.4.12.8 Representation of Dose Forms

These dose forms should be selected from a standard reference of dose forms. (An appropriate source to provide a defined list of pharmaceutical dose forms is still under discussion). The following rules will apply to display of dose forms in the SNOMED CT International Release.

<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP-FOR-1</td>
<td>The dose form of a concept.</td>
</tr>
<tr>
<td>APP-FOR-2</td>
<td>Products dispensed as powders for solution, powder for parenteral solution or powder for parenteral suspension: the dose form and strength is as the powder itself, because the final concentration is not known.</td>
</tr>
<tr>
<td>APP-FOR-3</td>
<td>A pack containing powder plus solvent is to be managed as a multicomponent pack and should be contained in the National release.</td>
</tr>
<tr>
<td>APP-FOR-4</td>
<td>For respiratory products, whether the presentation is a metered dose pressurised inhalation or a dry powder for inhalation, will be represented in the International Release, but the type of inhalator (breath-actuated, CFC free etc) will not be defined any more specifically than that in the International release. If a more granular representation is required it will be maintained in the appropriate National release.</td>
</tr>
<tr>
<td>APP-FOR-5</td>
<td>Powder for oral suspension that is intended to be dispensed in a reconstituted state of a standard concentration should be represented as oral suspensions.</td>
</tr>
</tbody>
</table>

6.2.4.12.8.1 Rules and examples relating to specific dose forms

6.2.4.12.8.1.1 Solid Oral Dose Forms

<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
<th>Further Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Modified release dose forms will be described as m/r in the preferred term</td>
<td>Diclofenac sodium 100mg m/r tablet</td>
<td>The expanded modified release is not used even in the longest term</td>
</tr>
<tr>
<td>2</td>
<td>For combination products the correct format will be: Drug A xmg/Drug B ymg form</td>
<td>Paracetamol 500mg/codeine phosphate 30mg tablet</td>
<td></td>
</tr>
</tbody>
</table>

Syntactic Normal Form: Name – Strength – Dose Form
<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>For combination products where an approved combination name is available the format follow that convention:</td>
<td>Co-Amilofruse 5mg/40mg tablet</td>
<td>If necessary this can be abbreviated to 5/40mg but the longest term should always contain the 5mg/40mg format</td>
</tr>
<tr>
<td>4</td>
<td>If the strength relates to a particular salt of the drug then the salt should be represented in the name field</td>
<td>Bosentan monohydrate 125mg tablet</td>
<td>Similarly, if the strength relates to the base drug then the salt is not represented in the name field</td>
</tr>
<tr>
<td>5</td>
<td>For specific packs where varying strengths of the same product are present, representation needs to occur in the strength field</td>
<td>Ropinirole 250mcg+500mcg+1000mcg tablet starter pack</td>
<td></td>
</tr>
</tbody>
</table>

6.2.4.12.8.1.2 Liquid and Semi-solid dose forms

**Syntactic Normal Form:** Name – Strength – Dose Form – unit

<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sugar-free is not expanded even in the longest term</td>
<td>Cimetidine 200mg/5mL s/f oral solution</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>* Unit dose is represented in the case of single dose presentations</td>
<td>Calcium phosphate 3100mg+colecalciferol 20mcg powder for oral suspension sachet Morphine sulphate 10mg/5mL oral solution 5mL unit dose vial</td>
<td>This is not how we represent it currently</td>
</tr>
<tr>
<td>3</td>
<td>Further examples:</td>
<td>Cefalexin 250mg/5mL oral suspension Linezolid 100mg/5mL granules for oral suspension</td>
<td>Continuous solid unit dose is not represented in term</td>
</tr>
</tbody>
</table>

6.2.4.12.8.1.3 Parenteral dose forms

**Syntactic Normal Form:** Name – Strength – Dose Form – unit
<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Liquid parenteral dose forms will have strength quoted in the per unit volume format. The unit dose will represent the final volume of the smallest single entity of the product that can be physically handled.</td>
<td>Frusemide 10mg/mL injection solution 2mL ampoule</td>
<td>The following examples would be incorrect: Frusemide 20mg/2mL injection solution ampoule Frusemide 20mg/2mL injection solution 2mL ampoule</td>
</tr>
<tr>
<td>2</td>
<td>For combination products the correct format is Drug A xmg/Drug B ymg.</td>
<td>Cilastatin 500mg/imipenem 500mg powder for infusion solution vial</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>If the strength is the representation of base chemical present then that should be reflected in the term.</td>
<td>Iodixanol 320mg(I)mg/mL injection solution</td>
<td>In this instance the 320mg relates to the equivalent amount of base Iodine and not the actual amount of Iodixanol</td>
</tr>
<tr>
<td>4</td>
<td>Insulin presentations are represented as follows</td>
<td>Insulin zinc suspension 100units/mL injection 10mL vial</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insulin soluble human 100units/mL injection 3mL cartridge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insulin biphasic lispro 25/75 100units/mL injection 3mL prefilled pen</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Further examples:</td>
<td>Enoxaparin 100mg/mL injection solution 1mL prefilled syringe</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adrenaline 1:1000 1mg/mL injection 1mL ampoule</td>
<td></td>
</tr>
</tbody>
</table>

6.2.4.12.8.1.4 Cutaneous and transcutaneous dose forms

**Syntactic Normal Form:** Name – Strength – Dose Form

<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strengths are added as a percentage or as xmg/g (mcg/g)</td>
<td>Calcipotriol 50mcg/g cream</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Rule</td>
<td>Example</td>
<td>Further information</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>---------</td>
<td>---------------------</td>
</tr>
<tr>
<td>2</td>
<td>For combination products where no approved name exists, the separate elements will be expressed in order of decreasing quantity. Where element quantities are identical, element order will follow alphabetical convention.</td>
<td>Calcipotriol 50mcg/g/Betamethasone 500mcg/g ointment</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Glyceryl trinitrate 15mg/24hours transdermal patch</td>
<td>What is the rule here — should we be representing them as xmg per 24 hours OR as the total amount of drug present in the reservoir</td>
</tr>
<tr>
<td>4</td>
<td>Further examples</td>
<td>Liquid paraffin 50%/white soft paraffin 50% ointment Alpha tocopheryl acetate 50iu/g cream</td>
<td>This is not how we currently represent this</td>
</tr>
</tbody>
</table>

6.2.4.12.8.1.5 Dose forms for Inhalation

**Syntactic Normal Form:** Name – Strength – Dose Form – unit

<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>* the unit dose will be represented in the case of single-dose presentations</td>
<td>Ipratropium bromide 250micrograms/mL nebuliser solution 1mL unit dose vial</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Further examples:</td>
<td>Colistimethate sodium 1million iu powder for nebulisation Mometasone furoate 400mcg breath-actuated dry powder inhaler Salbutamol 100mcg inhaler</td>
<td></td>
</tr>
</tbody>
</table>

6.2.4.12.8.1.6 Eye, Ear, Nose dose forms

**Syntactic Normal Form:** Name – Strength – Dose Form – [unit dose]*
### Further examples: 2

<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
</tr>
</thead>
</table>
| 2   | Further examples: | Chloramphenicol 1% eye ointment  
Pilocarpine 20micrograms m/r ocular insert  
Naphazoline HCl 0.01%/hamamelis water 12.5% eye drops  
Homatropine hydrobromide 2% eye drops |

### 6.2.4.12.8.1.7 Rectal/Vaginal Dose Forms

**Syntactic Normal Form:** Name – Strength – Dose Form – [unit dose]*

<table>
<thead>
<tr>
<th>No.</th>
<th>Rule</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>* In the case of single-use preparations, the unit dose will be expressed as part of the term</td>
<td>Phosphates Formula B long tube enema 128mL sachet</td>
</tr>
<tr>
<td>2</td>
<td>Combination packs are represented as follows</td>
<td>Clotrimazole 100mg/1% pessaries+cream</td>
</tr>
</tbody>
</table>
| 3   | Further examples: | Hydrocortisone acetate 10% rectal foam  
Diclofenac sodium 100mg suppository  
Clotrimazole 200mg pessary |

### 6.2.4.12.9 Units of Measure

Editorial Policy: Units of Measure are used to quantify the value of strength of active ingredient.

The following rules will apply to display of units of measure in the *SNOMED CT International Release.*
<table>
<thead>
<tr>
<th>Rule ID</th>
<th>Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>APP-UOM-1</td>
<td>SI units will be used where appropriate at NPMP level</td>
</tr>
<tr>
<td>APP-UOM-2</td>
<td>If the value is equal to or greater than 1000 milligram (&quot;mg&quot;), convert to and display as gram (&quot;g&quot;). If the value is less than 1 milligram (&quot;mg&quot;) convert to and display as microgram. If the value is equal to or greater than 1000 millilitre (&quot;mL&quot;), convert to and display as litre (&quot;L&quot;). Note: for large volume parenterals injections, irrigation solutions, haemodialysis and peritoneal dialysis solutions display as millilitres (&quot;mL&quot;) If the value is less than 1 micromole do not convert. Where the strength unit of measure would vary for the moiety BoSS and moiety with modifier BoSS according to this rule, all units of measure for the BoSS will be standardised according to the unit of measure for the active BoSS. For example: Pharmaceutical ingredient strength: mometasone furoate 1 mg/g Moiety with modifier BoSS strength: mometasone furoate 1 mg/g Moiety BoSS strength: mometasone 0.82 mg/g (not mometasone 820 microgram/g)</td>
</tr>
</tbody>
</table>

The Units of Measure list:

<table>
<thead>
<tr>
<th>Description</th>
<th>UNIT/PROPORTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASS</td>
<td></td>
</tr>
<tr>
<td>kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>kilogram /litre</td>
<td>kg/L</td>
</tr>
<tr>
<td>gram</td>
<td>g</td>
</tr>
<tr>
<td>gram/gram</td>
<td>g/g</td>
</tr>
<tr>
<td>gram/milliliter</td>
<td>g/mL</td>
</tr>
<tr>
<td>gram /litre</td>
<td>g/L</td>
</tr>
<tr>
<td>milligram</td>
<td>mg</td>
</tr>
<tr>
<td>milligram/metered dose</td>
<td>mg/metered dose</td>
</tr>
<tr>
<td>milligram/gram</td>
<td>mg/g</td>
</tr>
<tr>
<td>milligram/milligram</td>
<td>mg/mg</td>
</tr>
<tr>
<td>milligram/millilitre</td>
<td>mg/mL</td>
</tr>
<tr>
<td>milligram /litre</td>
<td>mg/L</td>
</tr>
<tr>
<td>Description</td>
<td>UNIT/PROPORTION</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>milligram/24 hour</td>
<td>mg/24 hours</td>
</tr>
<tr>
<td>microgram</td>
<td>microgram</td>
</tr>
<tr>
<td>microgram/metered dose</td>
<td>microgram/metered dose</td>
</tr>
<tr>
<td>microgram/gram</td>
<td>microgram/g</td>
</tr>
<tr>
<td>microgram/millilitre</td>
<td>microgram/mL</td>
</tr>
<tr>
<td>microgram/litre</td>
<td>microgram/L</td>
</tr>
<tr>
<td>microgram/24 hour</td>
<td>microgram/24 hours</td>
</tr>
<tr>
<td>nanogram</td>
<td>nanogram</td>
</tr>
<tr>
<td>nanogram/gram</td>
<td>nanogram/g</td>
</tr>
<tr>
<td>nanogram/millilitre</td>
<td>nanogram/mL</td>
</tr>
<tr>
<td>VOLUME</td>
<td></td>
</tr>
<tr>
<td>litre</td>
<td>L</td>
</tr>
<tr>
<td>litre/litre</td>
<td>L/L</td>
</tr>
<tr>
<td>millilitre</td>
<td>mL</td>
</tr>
<tr>
<td>millilitre/millilitre</td>
<td>mL/mL</td>
</tr>
<tr>
<td>millilitre/litre</td>
<td>mL/L</td>
</tr>
<tr>
<td>millilitre/gram</td>
<td>mL/g</td>
</tr>
<tr>
<td>microlitre</td>
<td>microlitre</td>
</tr>
<tr>
<td>microlitre/gram</td>
<td>microlitre/g</td>
</tr>
<tr>
<td>microlitre/millilitre</td>
<td>microlitre/mL</td>
</tr>
<tr>
<td>microlitre/litre</td>
<td>microlitre/L</td>
</tr>
<tr>
<td>nanolitre</td>
<td>nanolitre</td>
</tr>
<tr>
<td>nanolitre/millilitre</td>
<td>nanolitre/mL</td>
</tr>
<tr>
<td>MOLECULAR EQUIVALENTS</td>
<td></td>
</tr>
<tr>
<td>mole</td>
<td>mol</td>
</tr>
<tr>
<td>Description</td>
<td>UNIT/PROPORTION</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>mole /litre</td>
<td>mol/L</td>
</tr>
<tr>
<td>millimole</td>
<td>mmol</td>
</tr>
<tr>
<td>millimole/millilitre</td>
<td>mmol/mL</td>
</tr>
<tr>
<td>millimole /litre</td>
<td>mmol/L</td>
</tr>
<tr>
<td>micromole</td>
<td>micromole</td>
</tr>
<tr>
<td>micromole/millilitre</td>
<td>micromole/mL</td>
</tr>
<tr>
<td>micromole /litre</td>
<td>micromole/L</td>
</tr>
<tr>
<td>BIOLOGICAL ACTIVITY</td>
<td></td>
</tr>
<tr>
<td>international unit</td>
<td>international unit</td>
</tr>
<tr>
<td>million international units</td>
<td>million international unit</td>
</tr>
<tr>
<td>international unit/millilitre</td>
<td>international unit/mL</td>
</tr>
<tr>
<td>international unit/gram</td>
<td>international unit/g</td>
</tr>
<tr>
<td>international unit/milligram</td>
<td>international unit/mg</td>
</tr>
<tr>
<td>international unit/microgram</td>
<td>international unit/microgram</td>
</tr>
<tr>
<td>allergy unit</td>
<td>allergy unit</td>
</tr>
<tr>
<td>antigen unit</td>
<td>antigen unit</td>
</tr>
<tr>
<td>anti-Xa international unit</td>
<td>anti-Xa international unit</td>
</tr>
<tr>
<td>D antigen unit</td>
<td>D antigen unit</td>
</tr>
<tr>
<td>Enzyme-Linked ImmunoSorbent Assay</td>
<td>ELISA unit</td>
</tr>
<tr>
<td>index of reactivity unit</td>
<td>IR</td>
</tr>
<tr>
<td>kallikrein inactivator unit</td>
<td>KI unit</td>
</tr>
<tr>
<td>Kyowa unit</td>
<td>Kyowa unit</td>
</tr>
<tr>
<td>million unit</td>
<td>million unit</td>
</tr>
<tr>
<td>pressor unit</td>
<td>pressor unit</td>
</tr>
<tr>
<td>protein nitrogen unit</td>
<td>protein nitrogen unit</td>
</tr>
<tr>
<td>Description</td>
<td>UNIT/PROPORTION</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>titre unit</td>
<td>titre</td>
</tr>
<tr>
<td>unit</td>
<td>unit</td>
</tr>
<tr>
<td>MICROBIOLOGICAL CULTURES</td>
<td></td>
</tr>
<tr>
<td>billion organisms unit</td>
<td>billion organisms</td>
</tr>
<tr>
<td>billion vibrios unit</td>
<td>billion vibrios</td>
</tr>
<tr>
<td>cell culture infectious dose 50% unit</td>
<td>CCID50 unit</td>
</tr>
<tr>
<td>colony forming unit</td>
<td>colony forming unit</td>
</tr>
<tr>
<td>international opacity unit</td>
<td>international opacity units</td>
</tr>
<tr>
<td>million cell culture infectious dose 50% unit</td>
<td>million CCID50 unit</td>
</tr>
<tr>
<td>million colony forming unit</td>
<td>million colony forming units</td>
</tr>
<tr>
<td>million organisms unit</td>
<td>million organisms</td>
</tr>
<tr>
<td>mouse lethal dose 50% unit</td>
<td>mouse LD50 unit</td>
</tr>
<tr>
<td>plaque forming unit</td>
<td>PFU</td>
</tr>
<tr>
<td>thousand organisms unit</td>
<td>thousand organisms</td>
</tr>
<tr>
<td>tissue culture infectious dose 50% unit</td>
<td>TCID50 unit</td>
</tr>
<tr>
<td>colony forming unit</td>
<td>colony forming unit</td>
</tr>
<tr>
<td>international opacity unit</td>
<td>international opacity units</td>
</tr>
<tr>
<td>million cell culture infectious dose 50% unit</td>
<td>million CCID50 unit</td>
</tr>
<tr>
<td>million colony forming unit</td>
<td>million colony forming units</td>
</tr>
<tr>
<td>million organisms unit</td>
<td>million organisms</td>
</tr>
<tr>
<td>mouse lethal dose 50% unit</td>
<td>mouse LD50 unit</td>
</tr>
<tr>
<td>plaque forming unit</td>
<td>PFU</td>
</tr>
<tr>
<td>thousand organisms unit</td>
<td>thousand organisms</td>
</tr>
<tr>
<td>tissue culture infectious dose 50% unit</td>
<td>TCID50 unit</td>
</tr>
<tr>
<td>tuberculin unit</td>
<td>tuberculin unit</td>
</tr>
</tbody>
</table>
### 6.2.4.12.10 Other Units of Measure

**Table 187: Summary Table**

<table>
<thead>
<tr>
<th>Unit of measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>%v/v</td>
<td>Percentage Volume in Volume number of millilitres of solute in 100ml of product</td>
</tr>
<tr>
<td>%w/v</td>
<td>Percentage Weight in Volume number of grams of solute in 100ml of product</td>
</tr>
<tr>
<td>%w/w</td>
<td>Percentage Weight in Weight number of grams of solute in 100g of product</td>
</tr>
<tr>
<td>%v/w</td>
<td>Percentage Volume in Weight number of millilitres of solute in 100g of product</td>
</tr>
<tr>
<td>cm</td>
<td>Centimetre</td>
</tr>
<tr>
<td>Mu</td>
<td>mega units</td>
</tr>
<tr>
<td>Mu/mL</td>
<td>mega units/millilitre</td>
</tr>
<tr>
<td>m</td>
<td>Metre</td>
</tr>
<tr>
<td>mg/16 hours</td>
<td>milligram/16hours</td>
</tr>
<tr>
<td>mg/72 hours</td>
<td>milligram/72hours</td>
</tr>
<tr>
<td>mg/kg</td>
<td>milligram/kilogram</td>
</tr>
<tr>
<td>microgram/actuation</td>
<td>microgram/actuation</td>
</tr>
<tr>
<td>microgram/24 hours</td>
<td></td>
</tr>
<tr>
<td>microgram/72 hours</td>
<td></td>
</tr>
<tr>
<td>mL/kg</td>
<td>millilitre/kilogram</td>
</tr>
<tr>
<td>Molar</td>
<td></td>
</tr>
<tr>
<td>mm</td>
<td>Millimetre</td>
</tr>
<tr>
<td>mM</td>
<td>millimolar</td>
</tr>
<tr>
<td>unit/gram</td>
<td></td>
</tr>
<tr>
<td>unit/mg</td>
<td></td>
</tr>
<tr>
<td>unit/mL</td>
<td>unit/millilitre</td>
</tr>
</tbody>
</table>

Additional units of measure will be added to this list as required.
6.2.4.12.11 Definition for Clinically Distinct Complexes and Clinically Significant Modifications

A clinically significant modification is defined as being when “the salt representation of the base materially changes the therapeutic potency of the base, the duration of action of the base, the onset of action of the base, the pharmacological target of the base or the adverse reaction profile of the base, such that prescribing and administration decisions should, in the opinion of an appropriate expert body, be made at the level of the salt representation of the base”.

New additions to this section are expected to be made after further discussion.

6.2.4.12.11.1 Clinically distinct complexes

Clinically distinct complexes are composed of two or more moiety concepts each of is intended to produce a therapeutic effect upon administration. The Medicinal Entity name will consist of the full name for the complex.

Clinically distinct complexes include:
- ranitidine bismuth citrate
- sulfadiazine silver
- hexamine hippurate

6.2.4.12.11.2 Discernible therapeutic differences to the moiety

A discernible therapeutic difference is defined as a modification to the moiety that materially changes the therapeutic potency of the moiety, the duration of action of the moiety, the onset of action of the moiety, the pharmacological target of the moiety or the adverse reaction profile of the moiety, such that prescribing and administration decisions should, in the opinion of an appropriate expert body, be made at the level of the modification to the moiety. The Medicinal Entity name will consist of the moiety name with modification, where it is deemed to be discernibly therapeutically different from the moiety.

Discernable therapeutic differences to the moiety may include modifications to the following moieties:
- lipid formulations
- liposomal formulations

For items that include discernible therapeutic differences to the moiety, the modification will follow the name of the substance. Where multiple modifications are present, the order will be determined on a case by case basis. For example:
- doxorubicin, pegylated liposomal

It should be noted that there may be cases where more than levels required at both ME and NPMP to represent the moiety with each individual modification separately.

6.2.4.12.11.3 Enantiomers

Enantiomers will be represented only if the enantiomers of a racemic mixture have proven significantly different therapeutic potencies, duration of action, onset of action, pharmacological targets or adverse reaction profiles. If, in the opinion of an appropriate expert body, prescribing and administration decisions should be made at the level of the modification to enantiomer, the Medicinal Product will represent the active enantiomer of a racemic mixture. For example:
- dexamphetamine
- levobupivacaine
- escitalopram
- esomeprazole

6.2.4.12.11.4 Micronized and Macrocrystal Formulations

The Medicinal Product will be represented as such if it has been formulated in either a micronised form which has been proven to increase the bioavailability of the active ingredient or a macrocrystal form which has been proven to alter the bioavailability or adverse effect profile of the active ingredient.
For items that include clinically significant micronised formulations, the modification will follow the name of the substance. Where multiple modifications are present, the order will be determined on a case by case basis.

For example:

griseofulvin, micronised
nitrofurantoin macrocrystals

6.2.4.12.12 Syntactic Normal Form

The syntactic normal form for a virtual medicinal product Description is:

```
Name -- Strength -- Dose Form -- Unit Dose
```

The syntactic normal form for an actual medicinal product Description is:

```
Name -- Flavor -- Strength -- Dose Form -- Unit Dose
```

The following sections treat

- Strength;
- Dose Form;
- Unit Dose; and
- Flavour

respectively.

6.2.4.12.12.1 Strength

The strength is that of the active ingredient, its value being quantified by see Units of Measure. Examples of the expression of strength are specified below:

<table>
<thead>
<tr>
<th>Concept Types</th>
<th>Formulation Types</th>
<th>Examples of Strength Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid oral dose forms</td>
<td>Tablets M/r capsules</td>
<td>50mg, 500mcg, 5/50</td>
</tr>
<tr>
<td></td>
<td>Granules</td>
<td>5mg/5mL, 7g/sachet, 3.5g</td>
</tr>
<tr>
<td></td>
<td>Oral powder</td>
<td>10mg, 750mg/sachet</td>
</tr>
<tr>
<td></td>
<td>Dual ingredient tablets</td>
<td>50mg/25mg</td>
</tr>
<tr>
<td></td>
<td>Medicated chewing gum</td>
<td>10mg</td>
</tr>
<tr>
<td>Liquid oral dose forms</td>
<td>Oral liquid</td>
<td>100mg/5mL, 500mcg/5mL, 250mg/250mg/5mL, 50mcg/mL, 62.5mg/5mL</td>
</tr>
<tr>
<td></td>
<td>Oral drops</td>
<td>5mg/mL, 125mg/1.25mL</td>
</tr>
</tbody>
</table>
### Examples of Strength Representation

<table>
<thead>
<tr>
<th>Concept Types</th>
<th>Formulation Types</th>
<th>Examples of Strength Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topical liquids</td>
<td>Oromucosal spray</td>
<td>400mcg/spray, 0.15%</td>
</tr>
<tr>
<td></td>
<td>Oromucosal gel</td>
<td>8.7%</td>
</tr>
<tr>
<td></td>
<td>Mouthwash</td>
<td>0.15%</td>
</tr>
<tr>
<td></td>
<td>Disinfectant solutions</td>
<td>0.05%, 1.5%/15%</td>
</tr>
<tr>
<td>Cutaneous dose forms</td>
<td>Cream, gel, ointment</td>
<td>2%, 0.1%/2%</td>
</tr>
<tr>
<td></td>
<td>Cutaneous liquid</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Cutaneous spray</td>
<td>0.5%</td>
</tr>
<tr>
<td></td>
<td>Transdermal spray</td>
<td>10mg/24hrs</td>
</tr>
<tr>
<td>Parenteral dose forms</td>
<td>Solution for injection</td>
<td>10mg/mL, 100mcg/mL, 25,000iu/mL, 5000units/mL, 5%</td>
</tr>
<tr>
<td></td>
<td>Solution for infusion</td>
<td>20%, 0.1%, 800mg/mL, 1%(50mg/50mL)</td>
</tr>
<tr>
<td></td>
<td>Powder for solution for injection</td>
<td>50mg, 1.5million iu 100,000iu, 30units, 500mg/500mg</td>
</tr>
<tr>
<td>Rectal/vaginal dose forms</td>
<td>Vaginal cream, Vaginal foam</td>
<td>0.92%, 2%, 25mg</td>
</tr>
<tr>
<td></td>
<td>Rectal cream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vaginal ring</td>
<td>2mg(7.5mcg/24hrs)</td>
</tr>
<tr>
<td></td>
<td>Rectal solution, vaginal solution</td>
<td>50%, 20mg/100mL, 10mg/2.5mL</td>
</tr>
<tr>
<td></td>
<td>Suppository, pessary</td>
<td>4g, 5mg, 30mg</td>
</tr>
<tr>
<td>Eye/ear/nose dose forms</td>
<td>Eye gel, Eye ointment</td>
<td>1%, 0.5%, 0.1%/0.5% 40mcg/mL</td>
</tr>
<tr>
<td></td>
<td>Eye drops</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nasal cream Nasal spray solution</td>
<td>0.1%</td>
</tr>
<tr>
<td></td>
<td>Ophthalmic insert</td>
<td>20mcg</td>
</tr>
<tr>
<td>Inhalation dose forms</td>
<td>Pressurised inhalation solution</td>
<td>100mcg, 100mcg/dose</td>
</tr>
<tr>
<td></td>
<td>Inhalation powder capsule</td>
<td>200mcg</td>
</tr>
<tr>
<td></td>
<td>Nebuliser solution</td>
<td>5mg/mL, 250mcg/mL</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Radiopharmaceutical precursor</td>
<td>250MBq</td>
</tr>
<tr>
<td></td>
<td>Kit for radiopharmaceutical preparation</td>
<td>74MBq/mL</td>
</tr>
<tr>
<td></td>
<td>Irrigation solution</td>
<td>0.02%</td>
</tr>
</tbody>
</table>

#### 6.2.4.12.2 Dose Form

The dose form is the pharmaceutical formulation of the product derived from the Summary of Product Characteristics or Label. These documents constitute the definition approved by the regulatory bodies of the European Pharmacopoeia Commission and the Food and Drug Administration (FDA) respectively. They will be based on those dose forms expressed in the Standard terms for pharmaceutical dosage forms published by the European Pharmacopoeia Commission and the additional terms approved by the FDA defined within the HL7 messaging standard.

#### 6.2.4.12.3 Unit Dose

The unit dose is the smallest single entity of the product that can be physically handled with the following defined deviations (see also General Modelling Rules / Heuristics on page 413 for further clarification).
Continuous liquids excluding eye-drops and topical liquids: where the unit dose is expressed in terms of the accepted normal sub-unit used as the basis of administration

Continuous solids: where the unit dose is expressed in terms of the accepted normal sub-unit used as the basis of administration

Continuous semi-solids eye-drops and topical liquids: where a consistent, physically measurable unit or sub-unit cannot be defined and which is therefore not instantiated

Where the unit dose and the dose form are duplicates e.g. tablet, the unit dose is not expressed again in the Description.

Flavour

Note: Flavour is only expressed when two or more clinically equivalent AMPs exist with different flavours.

6.2.4.12.13 Nomenclature

The preferred Descriptions used in the SNOMED CT core are those based on the rINN (Recommended International Non-Proprietary Name). The BAN (British Approved Name) should only be used in the UK extension, whilst the USAN (United States Adopted Name) should only be used in the USA extension.

6.2.4.12.14 Recommended International Non-proprietary Name (rINN)

The generic name given following the World Health Organization guidelines on naming. Does not imply recommendation of the use of the substance in medicine or pharmacy. There are different stages of the procedure: pINN = "proposed International Non-proprietary Name"/ rINN ="recommended International Non-proprietary Name."

As per our agreed recommendation we prefer to use Recommended International Non-Proprietary Names (rINNs) Within SCT Preferred Descriptions

- The relegation of British Approved Names (BANs) from preferred status to synonymous status where they differ from the INN list and the addition of rINNs as the preferred Description.
- The concept categories that require to be managed by this process have been identified by the Medicines Control Agency (MCA) in the UK.
- The relegation of United States Approved Names (USANs) from preferred status to synonymous status where they differ from the INN list and the addition of rINNs as the preferred Description.

6.2.4.12.15 United States Adopted Names (USAN)

A non-proprietary designation for any compound used as a drug, established by negotiation between the manufacturer of the compound and a nomenclature committee known as the USAN Council, which is sponsored jointly by the American Medical Association, the American Pharmaceutical Association, and The United States Pharmacopoeia Convention. A liaison representative of the United States Food and Drug Administration sits on the USAN Council. The term is currently limited to names adopted by the Council since June, 1961. These names will appear as the monograph titles in the official compendia, USP and NF, when and if the respective drugs are admitted to either compendium.22

6.2.4.12.16 British Approved Name (BAN)

An official non-proprietary name approved by the British Pharmacopoeia Commission.23

6.2.4.12.17 Specific pharmaceutical forms

The List of Standard Terms, as devised by the European Commission states clearly that the term modified-release is not sufficiently precise and instead further categorises these into one of the

---

22 Source: http://www.mercksource.com
23 Source: http://www.mercksource.com
following options: *Extended-release, Targeted-release, Prolonged-release, Delayed release, Gastro-resistant.* There is no exact representation of *e/c tablets* or capsules and these would be termed as gastro-resistant according to the European Commission.

Alternatively, the British Pharmacopoeia (BP 2002) includes the following definitions:

*Modified release preparation:* where the rate and/or place of release of the active substance(s) is different from that of a conventional-release dosage form, administered by the same route. This deliberate modification is achieved by a special formulation design and/or manufacturing method.

The BP includes prolonged-release, delayed-release and pulsatile-release preparations as all belonging to the class of modified release preparations. It does not include gastro-resistant formulations in this Description.

*Gastro-resistant capsules/tablets:* are delayed release capsules that are intended to resist the gastric fluid and to release their active substance(s) in the intestinal fluid.

### 6.2.4.12.17.1 Editorial Rules
#### 6.2.4.12.17.1.1 Modified release preparation

Where the rate and/or place of release of the active substance(s) is different from that of a conventional-release dosage form, administered by the same route. This deliberate modification is achieved by a special formulation design and/or manufacturing method.

The BP includes prolonged-release, delayed-release and pulsatile-release preparations as all belonging to the class of modified release preparations. It does not include gastro-resistant formulations in this Description.

#### 6.2.4.12.17.1.2 Gastro-resistant capsules/tablets

The *Description* enteric-coated (e/c) will be used to describe products that have been formulated to be gastro-resistant i.e. products that have a delayed release formulation that are intended to resist the gastric fluid and to release their active substance(s) in the intestinal fluid.

#### 6.2.4.12.17.1.3 Intrathecal injections

From a clinical safety point of view there is arguably a case for using the pharmaceutical form - intrathecal injection. This is not in keeping with current practise, which dictates that clinical use of a product, and/or route of administration should not be intuitive in the term. However, special considerations apply to the formulation of intrathecal injections (as they do in fact to epidural injections also, which may also need to be specially considered). Any intra-spinal injection must be presented as a single-dose formulation and must not contain bactericides nor antioxidants (ref BPC 12th Ed pg 93). A complete list of parenteral preparations requiring specific consideration is given below:

- **Intra-arterial injections** must not contain bactericides
- **Intracardiac injections** must not contain bactericides
- **Intrathecal/Epidural** injections must not contain bactericides/antioxidants

*Intra-ocular injections* can be categorised as either *subconjunctival, intracameral, intravitreous* or *retrobulbar*. Whilst restrictions do not apply to subconjunctival injections, bactericides should be avoided in all other types of inter-ocular injections and the recommendation is that antioxidants should be avoided.([It's better to follow the manufacturer's specific indication whether the product is only intended for particular route or depends upon the physician's assessment](#))

The use case scenario for representing certain parenterals in this manner is that Decision Support Systems would be able to highlight pharmaceutical forms specifically for certain routes of administration. One possible use would be to show a warning if a non-intrathecal preparation was prescribed for an intra-thecal procedure.

This method of representation needs further consideration.

### 6.2.4.12.18 General Modelling Rules / Heuristics
#### 6.2.4.12.18.1 Plurality

All VMPs and AMPs will be conceptually described as singular entities i.e. tablet as opposed to tablets, capsule as opposed to capsules.
6.2.4.12.18.2 Decimal points

All expressions of strength will avoid using decimal expressions starting with the integer 0. That is:

- 500mcg instead of 0.5mg
- 500mL instead of 0.5L

However, decimal expressions commencing with an integer other than 0 will be used in preference to non-decimal greater than or equal to 1000.

i.e. 2.5mg will be used as opposed to 2500mcg

6.2.4.12.18.3 Additional descriptors

Flavours will be included between the name and the strength field of AMPs only.

- e.g. Fybogel orange 3.5g/sachet granules

6.2.4.12.18.4 Unique terms

All preferred terms regardless of character length will be unique within the Pharmaceutical / biologic product hierarchy.

6.2.4.12.18.5 Units

The word units must appear in the preferred term. If the facility to distribute abbreviated Descriptions is delivered this will not be abbreviated to unit but to u.

In the preferred term, the number of units must be expanded fully:

<table>
<thead>
<tr>
<th>Units</th>
<th>Expanded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000units</td>
<td>not 1ku</td>
</tr>
<tr>
<td>9000units</td>
<td>not 9ku</td>
</tr>
<tr>
<td>10,000units</td>
<td>not 10ku</td>
</tr>
<tr>
<td>100,000units</td>
<td>not 100ku</td>
</tr>
<tr>
<td>10megaunits</td>
<td>not 10mu</td>
</tr>
</tbody>
</table>

However, if the facility to distribute abbreviated Descriptions is delivered these abbreviations will be used in the abbreviated Description.

There will be no spaces or dashes in units Descriptions.

i.e. megaunits not mega units, or mega-units

iu not i u, or i-u

There will be no spaces between the number and the units within the term.

i.e. 10units not 10 units.

6.2.4.12.18.6 Salts

Where appropriate to the Description the salt will always be written in full in the preferred term. If the facility to distribute abbreviated Descriptions is delivered an abbreviation of the salt will be used in the abbreviated Description. The preferred means of abbreviating the salt will be to use the IUPAC convention where this is considered understandable by the average practising clinician.

Example:

<table>
<thead>
<tr>
<th>Full salt</th>
<th>– hydrochloride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbreviation</td>
<td>– HCl</td>
</tr>
</tbody>
</table>

6.2.4.12.18.7 Unit Dose Representation

The table in this section identifies the applicability of unit dose representation.
The unit dose is the representation of the smallest physical entity of a product that can be physically handled.

Further work is required to identify how each of the following groups are accurately handled, in terms of authoring, with regard to expression of strength, pharmaceutical form and unit dose.

<table>
<thead>
<tr>
<th>Dose form</th>
<th>Theoretical Unit Dose (examples)</th>
<th>Unit Dose representation (Yes/No)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid oral dose forms e.g.</td>
<td>Tablet</td>
<td>No</td>
<td>In these instances the unit dose is the same as the pharmaceutical form i.e. one tablet or one capsule and is not duplicated within the term</td>
</tr>
<tr>
<td>Tablets, Capsules</td>
<td>Capsule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous solids e.g.</td>
<td>5g</td>
<td>No</td>
<td>In the case of Sennokot granules, the unit dose is 5g of granules administered from a 100g pot. As in the case of oral liquids (see below), the unit dose is therefore used as the basis of administration and strength representation and is not duplicated in the term.</td>
</tr>
<tr>
<td>granules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral liquids</td>
<td>5mL</td>
<td>No</td>
<td>The unit dose for oral liquids and other continuous liquids is expressed in terms of the sub-unit used as the basis of administration—generally 5mL. In theory, the oral liquid concept would be described as, for example, Ampicillin 250mg/5mL oral suspension 5mL but since the unit dose is expressed as part of the strength it is not duplicated within the term</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Except for single-dose presentations</td>
</tr>
</tbody>
</table>

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### Unit Dose Representation

<table>
<thead>
<tr>
<th>Dose form</th>
<th>Theoretical Unit Dose (examples)</th>
<th>Unit Dose Representation (Yes/No)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenteral preparations</td>
<td>Vial</td>
<td>Yes</td>
<td>In these instances the unit dose will be represented as the smallest physical entity that the product is available as, for example, 10mL ampoule, 50mL vial, 1mL prefilled syringe. The pharmaceutical form will be identified as solution for injection, powder for solution for injection etc.</td>
</tr>
<tr>
<td>(single-use presentations)</td>
<td>2mL Ampoule</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1mL Prefilled syringe</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20mL vial</td>
<td>No</td>
<td>Multidose vials need special consideration since, unlike single-use products, the smallest physical presentation of the product is not identical to the intended administration volume. For example Menjugate meningococcal vaccine is available in a 10-dose vial. The unit dose administered to the patient is 0.5mL reconstituted solution. In these instances, these products should theoretically be treated in a similar fashion to continuous liquids. However, more work needs to be done to verify how these are handled.</td>
</tr>
<tr>
<td></td>
<td>50mL vial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-dose vial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutaneous preparations e.g. creams, sprays</td>
<td>1 spray</td>
<td>No</td>
<td>In these instances, the unit dose is non-quantifiable and cannot be expressed</td>
</tr>
<tr>
<td></td>
<td>1 application of cream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose form</td>
<td>Theoretical Unit Dose (examples)</td>
<td>Unit Dose representation (Yes/No)</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>----------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Inhalation preparations</td>
<td>1 puff</td>
<td>No</td>
<td>In the case of Salbutamol inhaler for example, the unit dose would be 1 actuation (puff); the strength is expressed as mcg per actuation (although in practise it is just the mcg that are expressed) so that the unit dose would be a duplication of the sub-unit used as the basis of administration.</td>
</tr>
<tr>
<td></td>
<td>1 inhaled rotacap</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 actuation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Except for single-use presentations</td>
<td>In the case of nebuliser solutions, these are often presented as single-dose units. In these cases, the unit dose would be expressed: Atrovent 250mcg/1mL nebuliser solution 1mL unit dose vial</td>
</tr>
<tr>
<td>Eye/ear/nose preparations</td>
<td>1 drop</td>
<td>No</td>
<td>As in the case of cutaneous preparations, the unit dose is non-quantifiable and as such is not expressed. However, in the case of single-dose preparations such as Minims, the unit dose can be expressed as 0.5mL unit dose vial for example.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dose form</th>
<th>Theoretical Unit Dose (examples)</th>
<th>Unit Dose representation (Yes/No)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal/rectal preparations</td>
<td>1 pessary</td>
<td>No</td>
<td>In the case of vaginal/rectal creams, these will be treated as in the case of cutaneous preparations (see above) where the unit dose is not quantifiable. In the case of suppositories and pessaries, these will be treated as in the case of solid oral dose forms where the pharmaceutical form is the same as the unit dose. In these instances, the unit dose will not be identified independently of the pharmaceutical form. In the case of single-dose enemas, the unit dose can be stated for example, Phosphates Formula B long tube enema 128mL sachet.</td>
</tr>
<tr>
<td></td>
<td>1 suppositiry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 application of cream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implants</td>
<td>1 implant</td>
<td>No</td>
<td>The unit dose and the pharmaceutical form are identical i.e. one implant, one implantation tablet etc.</td>
</tr>
</tbody>
</table>

6.2.4.12.18.8 Miscellaneous standard conventions

*Expressions of volume will follow the SI naming convention.*

i.e. mL not ml or ML, L not l.

All VMP *Descriptions* will begin with an uppercase character or integer. The remainder of the characters will be lower case unless part of an SI naming convention. AMP *Descriptions* will begin with an uppercase character or integer unless predetermined by the registered trade name as expressed in the Summary of Product Characteristics or Label. All other characters in the AMP name will be lower case unless part of an SI naming convention or predetermined by the registered trade name.

The *preferred term* for any drug name will use the Recommended International Non-proprietary Name. Domain specific naming conventions e.g. United States Approved Name and British Approved Name will be entered as synonyms with the facility to promote to preferred status within domain specific applications.

Multi ingredient products should be represented by a space+space sign in b/w two ingredients while avoiding a / or a :.

6.2.4.12.18.9 Products with dual represented strengths

*Example: Tenecteplase 8000iu(40mg) powder and solvent for injection solution vial.*

From author analysis of the Summary of Product Characteristics or Label it will be ascertained how the manufacturer expresses strength within the *Descriptions* used both in naming and advising on administration of the product. If these documents consistently use only one in *Description* and dosing information the
Description will reflect only this. Where the documents uses both (as in the example cited above), either
together or separately within different sections, both will be used.

6.2.4.12.18.10 Plastic ampoules

The fact that the ampoule is plastic is not clinically significant; Hence as far as the VMP goes
this will not be represented in the term. However, in the AMP, the plasticity of the ampoule is generally
represented in the name.

6.2.4.12.18.11 Sterile-wrapped injections

In this case, the fact that the ampoules/vials are sterile wrapped is clinically significant in
terms of usage for example, sterile-wrapped injections would be used in a sterile environment ie theatre.
As such, this feature needs to be represented in both the VMP and the AMP. The correct format will be
sterile-wrapped with a hyphen.

6.2.4.12.18.12 Polyfusors

A VMP should not have any brand attributable information in its Description and therefore
it is not permissible to use the term Polyfusor in the VMP. However, if these are termed bottles or bags
the Description becomes ambiguous with the user automatically assuming glass bottles and PVC collapsible
bags. The two key points about a Polyfusor are that they are semi-rigid and made of polyethylene. This
latter point is of vital importance when it comes to issues such as latex allergy (where polyfusors form
the infusion therapy in an operating theatre's latex free kit) and drug: infusion computability (where e.g.
GTN is adsorbed onto a standard PVC bag surface). It has been proposed therefore to describe the unit
dose of all polyfusors (and any other such container) as a POLYETHYLENE BOTTLE in the VMP.

6.2.4.12.18.13 Style guide rules for Radiopharmaceuticals:

6.2.4.12.18.13.1 Radionuclide name

The complete salt name (eg calcium chloride) will appear before the isotope
(45Ca), which will be in the format atomic number (45 in this case) followed by the chemical symbol (Ca)
e.g Salt – (number – symbol)

Examples:

Calcium Chloride (45Ca) is correct
Calcium (45Ca) Chloride is incorrect
Calcium Chloride (Ca45) is incorrect

6.2.4.12.18.13.2 Strength

Strength representation does not occur in any radiopharmaceutical product term

6.2.4.12.18.13.3 Unit dose

Unit dose representation is only applicable to those radiopharmaceutical product terms that
are NOT reconstituted radiolabelling kits i.e. only therapeutic and diagnostic radiopharmaceutical products
supplied as ready to use products should have a unit dose in the term.

In addition, unreconstituted labelling kits should have a unit dose specified.

6.2.4.12.18.13.4 Examples of radiopharmaceutical terms:

Sodium phosphate [32P] injection solution 5mL vial
Strontium chloride [89Sr] injection solution 1mL vial
MIBG [123I] injection solution 1mL vial

These terms have unit dose and volume since they are supplied as ready to use radiopharmaceuticals. They
do not have any strength representation.

Technetium [99Tc] albumin microspheres injection solution
Technetium [99Tc] gluconate injection solution

These terms have neither strength nor unit dose representation since they are reconstituted radiolabelled
products

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Tin colloid powder for injection solution vial
Tin pyrophosphate BP powder for injection solution vial

**Note:**
The above two products have no radioactivity. They are simply carrier substances awaiting reconstitution with a radioactive label. These terms would be used for ordering/stock control purposes within the pharmacy and not for entry into a patient's clinical record. They have no strength but a unit dose is specified.

### 6.2.4.12.19 Abbreviations

Currently *SNOMED* concepts are described by a single unabbreviated term. There are discussions due to take place regarding the requirement for a standardised abbreviated term. The list below identifies acceptable abbreviations that should be used during any authoring processes.

<table>
<thead>
<tr>
<th>LONGEST TERM</th>
<th>Abbreviation 1</th>
<th>Abbreviation 2</th>
<th>Shortest abbreviation allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridge</td>
<td>cart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-V infusion</td>
<td>i-v inf</td>
<td>iv inf</td>
<td>inf</td>
</tr>
<tr>
<td>Prefilled syringe</td>
<td>p/f syringe</td>
<td>p/f syrg</td>
<td>pf syrg</td>
</tr>
<tr>
<td>Syringe</td>
<td>syrg</td>
<td></td>
<td>syrg</td>
</tr>
<tr>
<td>Units</td>
<td></td>
<td>u²⁴</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>fem</td>
<td></td>
<td>f</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>Paediatric</td>
<td>paed</td>
<td></td>
<td>p</td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td>sml</td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Medium</td>
<td>med</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Large</td>
<td>lge</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Extra large</td>
<td>x-lge</td>
<td></td>
<td>XL</td>
</tr>
</tbody>
</table>

### 6.2.4.12.20 Type of drug preparation

This section of the hierarchy lists the various pharmaceutical/biologic forms that a preparation can take. For example, tablet, oral liquid, injection etc. In the table below, these types have been mapped to the VTM sub-categories.

**Table 188: Summary table**

<table>
<thead>
<tr>
<th>Type</th>
<th>VTM sub-Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant (product)</td>
<td>Implantable</td>
<td></td>
</tr>
<tr>
<td>Implantation tablet (product)</td>
<td>Implantable</td>
<td></td>
</tr>
<tr>
<td>Implantation chain (product)</td>
<td>Implantable</td>
<td></td>
</tr>
<tr>
<td>Implant dosage form (product)</td>
<td>Implantable</td>
<td></td>
</tr>
</tbody>
</table>

²⁴ 'Unit' is not to be used.
<table>
<thead>
<tr>
<th>Type</th>
<th>VTM sub-Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenteral drug preparation (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Injection (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Injection solution (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Injection suspension (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Injection emulsion (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Injection powder (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Powder for injection solution (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Powder for injection suspension (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Powder and solvent for injection solution (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Powder and solvent for injection suspension (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Injection concentrate (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Intravenous infusion (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Infusion solution (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Infusion powder (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Powder for infusion solution (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Powder and solvent for infusion (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Infusion concentrate (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Solvent for parenteral use (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Radiopharmaceutical preparation kit (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Radiopharmaceutical dosage form (product)</td>
<td>Injectable</td>
<td>Could also be oral use</td>
</tr>
<tr>
<td>Parenteral dosage form (product)</td>
<td>Injectable</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>VTM sub-Type</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Oral drops (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral drops solution (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral drops suspension (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral drops emulsion (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral liquid (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral solution (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral suspension (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Oral emulsion (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Powder for oral solution (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Powder for oral suspension (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Granules for oral solution (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Granules for oral suspension (product)</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Powder and solvent for oral solution (product)</td>
<td>Oral</td>
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<td>VTM sub-Type</td>
<td>Comments</td>
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</tr>
<tr>
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<td>More than one sub-type</td>
</tr>
<tr>
<td>Nasal cream (product)</td>
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<td>Nasal gel (product)</td>
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<td>Nasal drops (product)</td>
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<td>Nasal drops solution (product)</td>
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<td>Nasal drops emulsion (product)</td>
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<td>Nasal powder (product)</td>
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<td>Nasal spray solution (product)</td>
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<td>Nasal spray suspension (product)</td>
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<td>Nasal spray emulsion (product)</td>
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<td>Nasal dosage form (product)</td>
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<td>Ear drops (product)</td>
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<td>Ear drops solution (product)</td>
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<td>Ear drops emulsion (product)</td>
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<td>Ear powder (product)</td>
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<td>Type</td>
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<td>Comments</td>
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<tr>
<td>Ear spray (product)</td>
<td>Aural</td>
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<td>Ear spray solution (product)</td>
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<td>Ear spray suspension (product)</td>
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<td>Ear spray emulsion (product)</td>
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<td>Ear wash (product)</td>
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<tr>
<td>Ear wash solution (product)</td>
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<td>Ear wash emulsion (product)</td>
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<td>Ear tampon (product)</td>
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<td>Ear stick (product)</td>
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<td>Otic dosage form (product)</td>
<td>Aural</td>
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<tr>
<td>Nebuliser liquid (product)</td>
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<tr>
<td>Nebuliser solution (product)</td>
<td>Respiratory</td>
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<td>Nebuliser suspension (product)</td>
<td>Respiratory</td>
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<tr>
<td>Powder for nebuliser suspension (product)</td>
<td>Respiratory</td>
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<tr>
<td>Powder for nebuliser solution (product)</td>
<td>Respiratory</td>
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<tr>
<td>Nebuliser emulsion (product)</td>
<td>Respiratory</td>
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<tr>
<td>Pressurised inhalation (product)</td>
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<tr>
<td>Pressurised inhalation solution (product)</td>
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<td>Pressurised inhalation emulsion (product)</td>
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<td>Inhalation powder (product)</td>
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<tr>
<td>Hard capsule inhalation powder (product)</td>
<td>Respiratory</td>
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<tr>
<td>Type</td>
<td>VTM sub-Type</td>
<td>Comments</td>
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<td>Inhalation vapour powder (product)</td>
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<td>Inhalation vapour capsule (product)</td>
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<td>Inhalation vapour capsule (product)</td>
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<td>Inhalation vapour tablet (product)</td>
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<td>Inhalation vapour tablet (product)</td>
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<td>Inhalation gas (product)</td>
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<td>Respiratory</td>
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<td>Powder and solvent for endotracheopulmonary instillation solution (product)</td>
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<td>Enema (product)</td>
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<td>Rectal suspension (product)</td>
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<td>Rectal emulsion (product)</td>
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<td>Powder for rectal suspension (product)</td>
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<td>Tablet for rectal solution (product)</td>
<td>Rectal</td>
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<td>Tablet for rectal suspension (product)</td>
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<td>Rectal tampon (product)</td>
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<td>Rectal dosage form (product)</td>
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<td>Drug suppository (product)</td>
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<td>Vaginal gel (product)</td>
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<td>Vaginal ointment (product)</td>
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<td>Vaginal foam (product)</td>
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<tr>
<td>Type</td>
<td>VTM sub-Type</td>
<td>Comments</td>
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<tr>
<td>Vaginal suspension (product)</td>
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<td>Vaginal emulsion (product)</td>
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<td>Tablet for vaginal solution (product)</td>
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<td>Pessary (product)</td>
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<td>Vaginal capsule (product)</td>
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<td>Hard vaginal capsule (product)</td>
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<td>Soft vaginal capsule (product)</td>
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<td>Effervescent vaginal tablet (product)</td>
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<td>Medicated vaginal tampon (product)</td>
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<td>Vaginal device (product)</td>
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<tr>
<td>Vaginal dosage form (product)</td>
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</tr>
<tr>
<td>Intravesical solution (product)</td>
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</tr>
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<td>Bladder irrigation (product)</td>
<td>Genitourinary</td>
<td></td>
</tr>
<tr>
<td>Powder for bladder irrigation (product)</td>
<td>Genitourinary</td>
<td></td>
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<tr>
<td>Urethral gel (product)</td>
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<tr>
<td>Urethral stick (product)</td>
<td>Genitourinary</td>
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</tr>
<tr>
<td>Intravesical AND/OR urethral dosage form (product)</td>
<td>Genitourinary</td>
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</tr>
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<td>Type of drug preparation (product)</td>
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</tr>
<tr>
<td>Fish insulin (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Porcine insulin (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Water soluble contrast medium (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Lipiodol (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>VTM sub-Type</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
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<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Radiographic iodinated contrast medium (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Types of insulin (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Types of contrast medium (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Drug preparation (product)</td>
<td>Not true 'types'</td>
<td></td>
</tr>
<tr>
<td>Peritoneal dialysis solution (dose form) (product)</td>
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<td></td>
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<tr>
<td>Haemofiltration solution (product)</td>
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<tr>
<td>Hemofiltration solution (product)</td>
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<tr>
<td>Haemodialysis solution (product)</td>
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<td>Hemodialysis solution (product)</td>
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<td>Haemodialysis solution concentrate (product)</td>
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<tr>
<td>Hemodialysis solution concentrate (product)</td>
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<tr>
<td>Endocervical gel (product)</td>
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<tr>
<td>Powder and solvent for endocervical gel (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Intrauterine device (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Radiopharmaceutical precursor (product)</td>
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<tr>
<td>Radionuclide generator (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Gastroenteral liquid (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Gastroenteral solution (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Gastroenteral suspension (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Gastroenteral emulsion (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Organ preservation solution (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Irrigation solution (product)</td>
<td>? Need an extra sub-type class</td>
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<tr>
<td>Stomach irrigation (product)</td>
<td>? Need an extra sub-type class</td>
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</tr>
</tbody>
</table>
6.2.5 Miscellaneous Topics

6.2.5.1 References for Editorial Rules and Known Problems

The approved set of detailed editorial rules and guidelines are documented in the SNOMED CT Editorial Guide. Parts of the Editorial Guide are reproduced verbatim in the User Guide.

Known problems and issues are not documented here but instead are tracked on the SNOMED CT Collaborative Space at csfe.aceworkspace.net, under project "IHTSDO". It is possible to review a brief summary of each project without a login, but if you would like access to the Collaborative Space, please contact collabnet(at)ihtsdo.org with your contact details and a list of the project(s) to which you would like access. Known problems and issues are found in the content projects tracker under project "IHTSDO".

6.2.5.2 Terms Prefaced with Symbols

There are some terms in SNOMED CT that are prefaced with a symbol in square brackets. These concept codes were inherited from CTV3 and were used to facilitate mapping to ICD-10. They have all been retired by moving them to the UK NHS extension, and are not recommended for use in clinical records.

Explanations of these term prefixes are as follows:

Table 189: Term Preface Symbols

<table>
<thead>
<tr>
<th>Type</th>
<th>VTM sub-Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastroenteral dosage form (product)</td>
<td></td>
<td>? Need an extra sub-type class</td>
</tr>
<tr>
<td>Endocervical dosage form (product)</td>
<td></td>
<td>? Need an extra sub-type class</td>
</tr>
<tr>
<td>Dialysis dosage form (product)</td>
<td></td>
<td>? Need an extra sub-type class</td>
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</tbody>
</table>
6.2.5.3 Negation

The meaning of some concept codes in SNOMED CT depends conceptually on negation (e.g. absence of X, lack of X, unable to do X etc).

6.2.5.3.1 Negation and Context

The hierarchy is intended to manage this kind of semantic situation. The concept model allows a concept code in the hierarchy to be related to the Clinical finding about which context is asserted. For example, Absence of nausea and vomiting (situation) is modelled as a Situation with explicit context in which the finding of Nausea and vomiting (disorder) is absent.

The inclusion of negated meanings introduces complications into query formulation, machine classification, and reasoning tasks. The inclusion of a NOT logical operator into the SNOMED CT compositional model could simplify modeling of negated meanings. The current release of SNOMED CT does not directly support classification using this operator, but some modeling formalisms in current use today (including database formalisms, Description Logic formalisms) include a NOT operator as a fundamental modeling primitive.

6.3 Machine Readable Concept Model

The Concept Model is the set of rules that govern the ways in which SNOMED CT concepts are permitted to be modelled using Relationships to other Concepts. The Machine Readable Concept Model (MRCM) represents these rules in a form that can be read by a computer and applied to test that concept definitions comply with the rules.

The primary requirements addressed by the current MRCM relate to supporting content authoring and validation prior to distribution. However, the MRCM also has a potential value for implementers as a source of the rules that determine whether particular postcoordinated expression refinements are permitted.

The MRCM is based on a logical model that specifies:

- CM-Domains: Sets of SNOMED CT concepts to which a common set of Concept Model Constraints apply.
- CM-Attributes: Sets of SNOMED CT concepts that can be used as relationship types.
- CM-Ranges: Sets of SNOMED CT concepts that can be used as values for a particular defining Relationship.
- CM-Constraints: Rules that determine which combinations of CM-Attributes and CM-Ranges may be applied to concepts in a CM-Domain.

The current prototype version of the MRCM is represented as a relational database schema with an XML schema to support export and import of data.

Subsequent activities within IHTSDO Working Group and related work by IHTSDO Members has identified requirements for additional representations that are more readily refinable to support implementation use-cases.

Note: An updated representation of the MRCM is in preparation are part of work on a consistent family of processable languages for querying, constraining and binding SNOMED CT. Based on current expectations a Technology Preview should be available in the first quarter of 2015.
Chapter 7

7 Terminology Services Guide

7.1 Representing SNOMED CT resources

7.1.1 Choosing a terminology server view

SNOMED CT Release Format 2 is designed to enable the distribution and use of a full historical view of SNOMED CT from its first release in 2002 up to its most recent release. This allows terminology servers to provide a range of different views of SNOMED CT. However, it does not require that all terminology servers support the full range of views.

Table 190 identifies three options for the views that a SNOMED CT terminology server may support. The simplest of these is the single snapshot view which provides access to a single release version. This closely matches the view provided by the original SNOMED CT release format (RF1). The most powerful full view which allows the server to provide access to any selected version of SNOMED CT from a single representation of the SNOMED CT resource. This makes full use of the version features in RF2. Alternatively a server may provide a selected set of snapshots representing versions of known interest to its users.

People designing a terminology server need to decide whether their server will only provide access to a single current view of the SNOMED CT resource or will also support retrospective views of earlier versions of the terminology. The single snapshot view is simplest to implement and matches the service most vendors offered with original SNOMED CT release format (RF1). A more complete view is now possible using Release format 2 and this offers several significant advantages. It supports incremental updates allowing smoother transition as new versions become available. It also allows changes between versions to be detected more easily and can be used to evaluate queries against an earlier version for comparative purposes.

People choosing a terminology server need to consider whether a server that only supports a single snapshot view of the current version meets their requirements. If they require access to previous versions a server that supports the full view is likely to be the best long term solution. A server that allows access to multiple discrete snapshots may provide a reasonable interim solution but may be less flexible and less easy to maintain.

Table 190: SNOMED CT views that may be supported by terminology servers

<table>
<thead>
<tr>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snapshot view</td>
<td>A snapshot view terminology service provides access to the content of the current state of all the components of the International Release and any chosen Extension Releases.</td>
</tr>
</tbody>
</table>
A "multi-snapshot view" terminology service provides access to:
- the content of the current state and content of all components of the International release and any chosen Extension Releases;
- the content of one or more additional snapshot views, each of which represents the state of all components at a different fixed point in time.

A "multi-snapshot view" terminology server may provide access to delta views that report the differences between two snapshot views. This is limited to comparisons of specific points represented by the available snapshot views.

A Full view terminology service provides access to:
- the complete content of the full International release and any chosen Extension Releases;
- the state and content of all components as they were at any specified point in time.

A full view terminology server should also provide access to views that show the changes to components between any two specified points in time.

The full view is required to support some SNOMED CT use cases but many requirements can be adequately met by providing access to a current Snapshot view. The multi-snapshot view is an approach that may meet some requirements that are not met by a single snapshot without requiring support for the Full view.

Note: terminology servers that do not support the Full view still need to be able to import from a Full release as Extension providers are not required to provide the snapshot or delta releases (Importing release types)

7.1.2 Choosing a technical approach

People designing a terminology server need to decide how they will store and access the SNOMED CT resources. This decision depends on a variety of factors including: types of Terminology services required, the technical environment in which development is undertaken and the experience of the developers.

People choosing a terminology server need to know whether the server will meet their requirements and whether it works effectively in their preferred technical environment. They will also wish to be sure it delivers the required functionality and performance. While they may not be directly interested in technical approach to representation of SNOMED CT resources, these design decisions are likely to affect the ability of a server to meet their requirements.

The following sub-sections briefly outline some of the technical options.

7.1.2.1 Direct use of release files in a relational database

The distributed release files can be imported directly into a database schema that matches the distribution file specification. This data then provides the core resource at the heart of a terminology server.

This direct use of distributed files in a relational database has the advantage of allowing simple installation. However, it may not be the most efficient approach in terms of performance or file size. Some terminology
services require relatively complex queries with multiple joins, and need to be completed in fractions of a second to provide an acceptable user interface.

**Example:** To display the set of subtype children of a concept with their preferred terms in a specified language or dialect requires joins several joins between concepts, Relationships, Descriptions and a language refset.

To search for a term matching a supplied pattern in a concept that represents a type of procedure also requires multiple joins to link the Descriptions with matching terms to the relevant concept and test whether it is a subtype of the 71388002 | Procedure (procedure) | concept.

The performance criteria of searches and joins in very large relational databases vary significantly. Therefore, different optimisations may need to be used to achieve acceptable response times according to the nature of the relational database system.

An additional consideration for RF2 implementations is the way in which alternative views are supported since, without optimisation these may have a significant impact on performance.

### 7.1.2.2 Alternative relational structures

There is no requirement to use the data structure as distributed. Other structures can be used provided that they are able to deliver the range of Terminology services required. Options include:

- Partially denormalised representations that omit direct representation of some components.
  **Example:** Frequently used information distributed as part of a Refset could be represented by direct inclusion of the added information as additional columns in the table representing the referenced component.

- Omission of some of the tables where a particular function is not required.
  **Example:** The Refset tables representing maps could be omitted if the intended uses of the terminology server explicitly exclude mapping.

- Replacement of some of the supporting tables with proprietary alternatives that deliver equivalent or enhanced functionality.
  **Example:** The word search support tables could be replaced by other tables or indices generated by the terminology server when loading the distribution files.

### 7.1.2.3 Non-relational structures

Although the primary distribution format is relational, this does not require terminology servers to utilise a relational database as the primary or only storage format. The requirements for terminology services may also be met by representing some or all of the distributed data in other forms including object-oriented databases, Extensible Mark-up Language (XML) and/or proprietary data structures. These structures may be used separately or, in some cases, in combination with a relational database.

### 7.1.3 Example of a Full View Relational Representation

This section outlines an example of a relational approach to representation of a full view of the SNOMED CT Resources. The example has been developed and tested using the Open Source database MySql Community Edition.

The example schema is based closely on the RF2 structure and is used in subsequent database MySQL Edition.

**Note:** The approach described here is only an illustrative example. It shows one way to represent the data but should not to be interpreted as a recommended or standard approach.

The general approach is as follows:

- Each datatype in the RF2 specification is expressed with a common mapping to a database datatype:
• Alternative implementations following the same general pattern could use a different datatype map but the mapping should be consistent within an implementation. Reasons for different datatype maps include implementer preferences and the capabilities of the database.

• Each of the main file types specified in RF2 is instantiated as a database table:
  • Each table is named for the component type (e.g. sct2_Concept, sct2_Description, sct2_Relationship, sct2_Identifier).
  • Each field in these tables has column name from the release file
  • Each field is assigned the appropriate datatype (and where appropriate size).

• Refsets are represented slightly differently from the other files:
  • One table structure for each distinct structure present in the release data:
    • der2_Refset.
    • der2_Reset_c.
    • der2_Refset_cc.
    • der2_Refset_ci.
    • der2_Refset_i.
    • der2_Refset_s.
    • der2_Refset_ss.
    • ... etc as new structures are added.
  • The first six fields in these tables have the common column names from the release file
  • The subsequent fields are named by type and position:
    • sctid1.
    • string1.
    • integer1.
    • ... etc.
  • This polymorphic field approach to column naming is used because column names may varies between release files for different Reference Set patterns, even when column data types are the same.

Note: Two other approaches could be used here.

1. A separate table for each type of Refset based on column names rather than on structure. This would require a several tables with similar types of Relationships to other components.

2. A single general purpose Refset table with multiple polymorphic fields. For example, strings that could be used to represent the other data types. This could cause inefficiencies for sctid type fields as the joins between these and target components would be heterogeneous.

7.1.3.1 Example Datatype Mapping for Relational View

The following table provides example mapping from the SNOMED CT RF2 datatypes to appropriate datatypes supported by MySql.

Table 191: Example Datatype Mappings

<table>
<thead>
<tr>
<th>RF2 Datatype</th>
<th>MySql Datatype</th>
<th>Comment on Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCTID</td>
<td>BIGINT</td>
<td>Both these datatypes represent 64-bit integers.</td>
</tr>
</tbody>
</table>
UUID does not have a native datatype for UUID. The BINARY(16) representation is most economical for storage and most efficient for indexing. This requires a transformation on storage or review. The example queries in this guide use the simple transformations functions shown in Table 192.

An alternative is to use CHAR or VARCHAR representations. This does not require the transformations noted above. However, use of VARCHAR (36) costs 38 bytes rather than 16 bytes per UUID and due to use of UTF8 using CHAR (36) consumes a fixed 108 bytes per UID in a MySql table. More importantly the index performance is poorer for these string representations.

<table>
<thead>
<tr>
<th>RF2 Datatype</th>
<th>MySql Datatype</th>
<th>Comment on Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>UUID</td>
<td>BINARY(16)</td>
<td>MySql treats the datatype name boolean as an alias for TINYINT. In the examples this mapping is made explicit.</td>
</tr>
<tr>
<td>Integer</td>
<td>INT</td>
<td>Both these datatypes represent 32-bit integers.</td>
</tr>
<tr>
<td>String</td>
<td>VARCHAR (Len)</td>
<td>VARCHAR is used in preference to CHAR as it provides more space efficient storage. Note that in the UTF8 encoded tables required for the MyISAM database reserves three bytes per character for fixed length strings. In contrast VARCHAR uses the number of bytes actually plus one or two bytes to specify length. Use of VARCHAR does result in some loss of performance but strings are only used in Descriptions, string refsets and Identifier tables. In all these cases strings with a significant range of lengths are used and the space penalty for using CHAR datatypes would be high.</td>
</tr>
<tr>
<td>Boolean</td>
<td>TINYINT</td>
<td>MySql treats the datatype name boolean as an alias for TINYINT. In the examples this mapping is made explicit.</td>
</tr>
<tr>
<td>Time</td>
<td>DATETIME</td>
<td>This is the full representation of date and time and is used to ensure compatibility with existing data and potential accommodation of time stamped data. The more compact DATE type could be used with current data as the effectiveTime is currently a date only representation. However, the more flexible DATETIME has been preferred in the examples because this emphasises the fact that in an International environment the effectiveTime implies the UTC time and thus the date alone is not a precise representation.</td>
</tr>
</tbody>
</table>

**Table 192: Example UUID transformation**

<table>
<thead>
<tr>
<th>Action</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load or insert to storage</td>
<td>SET [column-name] = UNHEX(REPLACE(@uid,‘-’,‘‘))</td>
</tr>
<tr>
<td>Select from storage</td>
<td>RenderUid([column-name])</td>
</tr>
<tr>
<td>UNHEX</td>
<td>A built in MySql function that converts a hexadecimal string to binary.</td>
</tr>
</tbody>
</table>
FUNCTION `RenderUid`(Uid blob) RETURNS varchar(36) CHARSET utf8
BEGIN
  SET @Tmp = Hex(uid);
  RETURN CONCAT(SUBSTRING(@Tmp,1,8),'-',SUBSTRING(@Tmp,9,4),'-',
  SUBSTRING(@Tmp,13,4),'-',SUBSTRING(@Tmp,17,4),'-',SUBSTRING(@Tmp,21));
END

7.1.3.2 Example Full View Concept Table

```
CREATE TABLE `sct2_concept` (
  `id` BIGINT NOT NULL DEFAULT 0,
  `effectiveTime` DATETIME NOT NULL DEFAULT '0000-00-00 00:00:00',
  `active` TINYINT NOT NULL DEFAULT 0,
  `moduleId` BIGINT NOT NULL DEFAULT 0,
  `definitionStatusId` BIGINT NOT NULL DEFAULT 0,
  PRIMARY KEY (`id`,`effectiveTime`) )
ENGINE=MyISAM DEFAULT CHARSET=utf8;
```

**Figure 71: Create Concept Table**

**Tip:** Some of the approaches to optimisation suggested elsewhere in the guide result in changes to this example schema. You may wish to consider these before implementing this schema.

```
LOAD DATA LOCAL INFILE 'path\sct2_concept_[AdditionalInfo].txt'
INTO TABLE `sct2_concept`
LINES TERMINATED BY '\r\n' IGNORE 1 LINES;
```

**Figure 72: Import Concept file**

7.1.3.3 Example Full View Description Table

```
CREATE TABLE `sct2_description`
(`id` BIGINT NOT NULL DEFAULT 0,
`effectiveTime` DATETIME NOT NULL DEFAULT '0000-00-00 00:00:00',
`active` TINYINT NOT NULL DEFAULT 0,
`moduleId` BIGINT NOT NULL DEFAULT 0,
`conceptId` BIGINT NOT NULL DEFAULT 0,
`languageCode` VARCHAR(3) NOT NULL DEFAULT '',
`typeId` BIGINT NOT NULL DEFAULT 0,
`Term` VARCHAR(255) NOT NULL DEFAULT '',
`caseSignificanceId` BIGINT NOT NULL DEFAULT 0,
PRIMARY KEY (`id`,`effectiveTime`),
KEY `sct2_description_concept` (`conceptId`) )
ENGINE=MyISAM DEFAULT CHARSET=utf8;
```

**Figure 73: Create Description Table**

**Tip:** Some of the approaches to optimisation suggested elsewhere in the guide result in changes to this example schema. You may wish to consider these before implementing this schema.

```
LOAD DATA LOCAL INFILE 'path\sct2_description_[AdditionalInfo].txt'
INTO TABLE `sct2_description`
LINES TERMINATED BY '\r\n' IGNORE 1 LINES;
```

**Figure 74: Import Description file**

ADD INDEX ix_sct2_description_3 ON `sct2_description`(`conceptId`,`typeId`,`languageCode`)

**Figure 75: Index Description Table - Concept**
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7.1.3.4 Example Full View relationships table
CREATE TABLE `sct2_relationship` (
`id` BIGINT NOT NULL DEFAULT 0,
`effectiveTime` DATETIME NOT NULL DEFAULT '0000-00-00 00:00:00',
`active` TINYINT NOT NULL DEFAULT 0,
`moduleId` BIGINT NOT NULL DEFAULT 0,
`sourceId` BIGINT NOT NULL DEFAULT 0,
`destinationId` BIGINT NOT NULL DEFAULT 0,
`relationshipGroup` INT NOT NULL DEFAULT 0,
`typeId` BIGINT NOT NULL DEFAULT 0,
`characteristicTypeId` BIGINT NOT NULL DEFAULT 0,
`modifierId` BIGINT NOT NULL DEFAULT 0,
PRIMARY KEY (`id`,`effectiveTime`),
KEY `sct2_relationship_source` (`sourceId`,`characteristicTypeId`,`typeId`,`destinationId`),
KEY `sct2_relationship_dest` (`destinationId`,`characteristicTypeId`,`typeId`)
) ENGINE=MyISAM DEFAULT CHARSET=utf8
Figure 76: Create relationships table
Tip: Some of the approaches to optimisation suggested elsewhere in the guide result in changes to
this example schema. You may wish to consider these before implementing this schema.
LOAD DATA LOCAL INFILE '[path]sct2_relationship_[AdditionalInfo].txt'
INTO TABLE sct2_relationship
LINES TERMINATED BY '\r\n' IGNORE 1 LINES;
Figure 77: Import Relationship file
7.1.3.5 Example Full View Identifier Table
CREATE TABLE `sct2_identifier` (
`identifierSchemeId` BIGINT NOT NULL DEFAULT 0,
`alternateIdentifier` VARCHAR(255) NOT NULL DEFAULT '',
`effectiveTime` DATETIME NOT NULL DEFAULT '0000-00-00 00:00:00',
`active` TINYINT NOT NULL DEFAULT 0,
`moduleId` BIGINT NOT NULL DEFAULT 0,
`referencedComponentId` BIGINT NOT NULL DEFAULT 0,
PRIMARY KEY (`identifierSchemeId`,`alternateIdentifier`,`effectiveTime`),
KEY `sct2_relationship_sctid` (`referencedComponentId`)
) ENGINE=MyISAM DEFAULT CHARSET=utf8
Figure 78: Create Identifier Table
Tip: Some of the approaches to optimisation suggested elsewhere in the guide result in changes to
this example schema. You may wish to consider these before implementing this schema.
LOAD DATA LOCAL INFILE '[path]sct2_identifier_[AdditionalInfo].txt'
INTO TABLE sct2_identifier
LINES TERMINATED BY '\r\n' IGNORE 1 LINES;
Figure 79: Index Identifier Table - Primary
7.1.3.6 Example Full View Refset Table
CREATE TABLE `sct2_refset_c` (
`id` binary(16) NOT NULL DEFAULT '\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0',
`effectiveTime` DATETIME NOT NULL DEFAULT '0000-00-00 00:00:00',
`active` TINYINT NOT NULL DEFAULT 0,
`moduleId` BIGINT NOT NULL DEFAULT 0,
`refsetId` BIGINT NOT NULL DEFAULT 0,
`referencedComponentId` BIGINT NOT NULL DEFAULT 0,
`sctId1` BIGINT NOT NULL DEFAULT 0,
PRIMARY KEY (`id`,`effectiveTime`),

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KEY `refset_c_id` (`refsetId`, `referencedComponentId`)
) ENGINE=MyISAM DEFAULT CHARSET=utf8;

Figure 80: Create Component Refset Table

Tip: Some of the approaches to optimisation suggested elsewhere in the guide result in changes to this example schema. You may wish to consider these before implementing this schema.

LOAD DATA LOCAL INFILE '[path]der2_cRefset_[AdditionalInfo].txt'
INTO TABLE `sct2_refset_c`
LINES TERMINATED BY '
' IGNORE 1 LINES
(@uid, `effectiveTime`, `active`, `moduleId`, `refsetId`, `referencedComponentId`, `sctId1`)
SET id=UNHEX(REPLACE(@uid,'-',''));

Figure 81: Import Component Refset File

7.2 Importing SNOMED CT release data

7.2.1 Choosing a Release Type to import

The first step in selecting the set of release files to be imported is to decide which Release Type will be used. SNOMED CT Release Format 2 specifies three distinct Release Types: full release, snapshot release and delta release. These are described in the table below.

The Release Format 2 specification states that:

• The SNOMED CT International Release will include all three Release Types;
• A SNOMED CT Extension Release must include the full release;
• A SNOMED CT Extension Release may optionally include a snapshot release and/or delta release.

A SNOMED CT-enabled terminology server must be able to import data from a full release because this is the only Release Type that is required to be produced by all Extension developers. A SNOMED CT-enabled terminology server should also be able to import from other Release Types where these are available as these may allow more efficient updating.

The choice of a particular Release Type depends on the type of terminology views that the terminology server is designed to support and on whether this is an initial import or a subsequent update.

Note: The requirement to be able to import data from the full release does not mean that all terminology servers must provide access to the complete historical set of data provided by a full release. The full release can be selectively imported to used to populate a snapshot view for applications that do not require access to historical data.

7.2.1.1 Release Types

Table 193 specifies the content of each of the Release Format 2 Release Types.

This table is followed by illustrations of each of the Release Types using the small same pattern of content development over seven release cycles. These illustrations highlight the key differences and the Relationships between the Release Types.

Table 193: SNOMED CT Release Types

<table>
<thead>
<tr>
<th>Release Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>The files representing each type of component contain every version of every component ever released.</td>
</tr>
<tr>
<td><strong>Release Type</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Snapshot</td>
<td>The files representing each type of component contain <strong>one</strong> version of every component released up to the time of the snapshot. The version of each component contained in a snapshot is the most recent version of that component at the time of the snapshot.</td>
</tr>
<tr>
<td>Delta</td>
<td>The files representing each type of component contain only component versions created since the previous release. Each component version in a delta release represents either a new component or a change to an existing component.</td>
</tr>
</tbody>
</table>

The seven columns in each of the following illustrations represent the content of seven releases (numbered 1-7). Each component is identified by a letters (A-K). A component version is represented by the identifying letter followed by a number (1-7) representing the release cycle in which that component version became effective.

*Figure 82* shows the content of a series of full releases. The yellow background colour highlights the set of component versions that are also present in the snapshot for the same release version (see *Figure 84*). Component versions are shown in grey in releases versions after they have been superseded by a new component version. Newly added component versions, shown in red, are also present in the delta for the same release version (see *Figure 83*).

The content of the full release in any chosen version is identical to the combined content of all the snapshot releases up to and including that version. Thus adding a delta release to the previous version of the full release creates the full release for the new version. The snapshot release is derived from the full release by removing all except the most recent version of each component.
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>A,1</td>
<td>A,1</td>
<td>A,1</td>
<td>A,1</td>
<td>A,1</td>
<td>A,1</td>
<td>A,1</td>
</tr>
<tr>
<td>B,1</td>
<td>B,1</td>
<td>B,1</td>
<td>A,4</td>
<td>A,4</td>
<td>A,4</td>
<td>A,4</td>
</tr>
<tr>
<td>C,1</td>
<td>B,2</td>
<td>B,2</td>
<td>B,1</td>
<td>B,1</td>
<td>B,1</td>
<td>B,1</td>
</tr>
<tr>
<td>D,1</td>
<td>C,1</td>
<td>C,1</td>
<td>B,2</td>
<td>B,2</td>
<td>B,2</td>
<td>B,2</td>
</tr>
<tr>
<td>E,1</td>
<td>D,1</td>
<td>C,3</td>
<td>C,1</td>
<td>C,1</td>
<td>B,6</td>
<td>B,6</td>
</tr>
<tr>
<td>F,2</td>
<td>E,1</td>
<td>C,4</td>
<td>C,4</td>
<td>C,3</td>
<td>C,6</td>
<td>C,6</td>
</tr>
<tr>
<td>G,2</td>
<td>E,1</td>
<td>D,1</td>
<td>D,1</td>
<td>C,4</td>
<td>D,1</td>
<td>D,1</td>
</tr>
<tr>
<td>H,3</td>
<td>F,3</td>
<td>F,2</td>
<td>F,2</td>
<td>C,6</td>
<td>E,1</td>
<td>E,1</td>
</tr>
<tr>
<td>I,4</td>
<td>G,2</td>
<td>G,2</td>
<td>F,3</td>
<td>E,1</td>
<td>F,2</td>
<td>F,2</td>
</tr>
<tr>
<td>J,5</td>
<td>H,3</td>
<td>H,3</td>
<td>F,3</td>
<td>F,3</td>
<td>H,6</td>
<td>H,6</td>
</tr>
<tr>
<td>K,7</td>
<td>I,4</td>
<td>J,5</td>
<td>G,2</td>
<td>H,6</td>
<td>K,7</td>
<td>K,7</td>
</tr>
</tbody>
</table>

Figure 82: Full release illustration
### Figure 83: Delta release illustration

<table>
<thead>
<tr>
<th>Earlier</th>
<th>DELTA RELEASES FOR SEVEN RELEASE CYCLES</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A,1</td>
<td>2</td>
</tr>
<tr>
<td>C,1</td>
<td>C,3</td>
<td>C,4</td>
</tr>
<tr>
<td>H,3</td>
<td>I,4</td>
<td>J,5</td>
</tr>
</tbody>
</table>

### Figure 84: Snapshot release illustration

<table>
<thead>
<tr>
<th>Earlier</th>
<th>SNAPSHOT RELEASES FOR SEVEN RELEASE CYCLES</th>
<th>Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A,1</td>
<td>2</td>
</tr>
<tr>
<td>C,1</td>
<td>C,3</td>
<td>C,4</td>
</tr>
<tr>
<td>H,3</td>
<td>I,4</td>
<td>J,5</td>
</tr>
</tbody>
</table>

**Note:** In a real SNOMED CT release each of the letters A-K would be replaced by a component id (a SNOMED CT identifier) and each of the release cycle numbers 1-7 would be replaced by the effectiveTime of a release version.

#### 7.2.1.2 Importing and maintaining a Full view

**7.2.1.2.1 Importing a Full view**

To provide access to the full view of the content of the SNOMED CT International Release, a terminology server must initially import content from the full release files for the International Release.
The complete content of all the main release files should be imported into the chosen internal representation.

Figure 85: Initial import to create a full view

Tip: The files that form part of a particular release can be identified by pattern matching based on the IHTSDO filenaming conventions (see Identifying release files using regular expressions).

7.2.1.2.2 Updating a Full view

A full view can be updated by one of the following approaches:

1. Append the content of the relevant delta release files to a previously created full view:
   - The delta files contain only the changes since a previous release. Appending the data from these files to the full view for the previous version creates the full view for the new version. There is no need to change or delete existing data.

   Caution: A delta release must be applied to the immediately previous version. Appending a delta release to earlier versions will result in omission of content and this will lead to significant errors when interpreting the data.
2. Filter the relevant full release files to generate a delta release then apply this as in 2 above:
   • The delta release consists of all items in the full release with an effectiveTime greater than the effectiveTime of the most recent previous release. Therefore, it is easy to filter a full release to generate a set of delta release files.
   • Alternatively a "virtual delta" release may be used by filtering the full release while importing.

   Note: This allows Extensions that are not distributed with delta releases to be processed by a general update process that is optimised to work with delta releases.

3. Use the full release files to completely replace previously imported data:
   • This follows the approach described earlier to import a full view.
7.2.1.2.3 Importing and updating Extensions for a Full view

To provide access to the full view of one or more Extensions, a terminology server must initially import content from the full release files for each of the required Extensions. Thereafter, the full view of each Extension can be maintained by using any of the techniques described for updating a full view.

When a full view of Extension data is initially imported or subsequently updated care needs to be taken to ensure the relevant versions of the International Release and any other Extensions on which it depends have been imported. Failure to follow do this may lead to errors as a result of references from Extension components to missing or out of date components in the International Release or in another Extension.

A full view may include more recent versions of the International Release than is required to support the Extension. In this case, when the Extension is viewed the International Release can, if necessary, be viewed as it would have been in the version to which the Extension is related. Similarly, if one Extension depends on content in another Extension, the version the Extension on which it depends may be a more recent version.

The table below summarises the compatibility between the full views of given versions of an Extension and the International Release. It also indicates the ways in which a full view may be used when the latest installed versions are not directly compatible. If one Extension depends on another Extension, the same considerations apply to compatibility between the versions of those Extensions.

Tip: The files that form part of a particular release can be identified by pattern matching based on the IHTSDO filing conventions (see Identifying release files using regular expressions).
Table 194: Compatibility between full views of versions of an Extension and the International Release

<table>
<thead>
<tr>
<th>Relationship between the version of the Extension and the International Edition</th>
<th>Notes on compatibility and usability</th>
</tr>
</thead>
</table>
| **Installed International Release is older than the version on which the Extension was based** | **Incompatible - unless recent Extension content is excluded.**  
The Extension may include Relationships to concepts that do not exist in this version of the International Release. This will lead to errors that cannot be reconciled while viewing the Extension content.  
A system with this mix of installed versions could be safely used by excluding the content of the more recent Extension versions. This can be done by excluding any Extension component-version with an effectiveTime of one of the versions based on a newer International Release. In effect this approach rolls back the Extension to the last Extension that is valid with the installed version of the International Release. |
| **Installed International Release is same version as the one on which the Extension was based** | **Fully compatible.**  
This is the version the Extension was created for so it should behave as intended. |
| **Installed International Release is newer than the version on which the Extension was based.** | **Compatible - subject to appropriate configuration and usage.**  
The International Edition for this version may include:  
• Additional components. These will not cause errors because the International Release does not reference the Extension and the Extension content cannot reference components that did not exist when in the version it was based on.  
• Changes to the state of some components. These changes may affect the interpretation of some parts of the Extension.  
However, despite these issues the full view resulting from this combination can be used in several ways:  
1. Configured to roll-back the International Release to the version on which the Extension was based. This can be done with a full release by creating a virtual view of the International Release components which excludes component versions with an effectiveTime greater than the version on which the Extension was based. This type of view is described in more detail in Implementing the State-Valid view.  
2. Configured to exclude the Extension. In this case the most recent version of the International Release can be viewed.  
3. Configured to use those parts of the Extension that support translation of International Release content. In this case, the Extension will enable translated rendering of pre-existing translated content. This would leave new and untranslated concepts to be rendered in English (or another available language).  
4. Accepting and working within the constraints imposed by the omissions and anomalies noted above. This mode should not be used routinely but may useful for assessing the impact of changes to the International Release on the Extension. |
7.2.1.3 Importing and maintaining a Snapshot view

7.2.1.3.1 Importing a Snapshot view

To provide access to the snapshot view of the content of the SNOMED CT International Release, a terminology server must initially do one of the following:

1. Import the content from a set of snapshot release files for a version of the International Release:
   - All the rows from a set of snapshot release files must be imported.

2. Create a snapshot from a set of full release files for a version of the International Release:
   - When creating a snapshot from a full release, only those rows that represent the most recent version of each component are imported.
   - Where two or more rows have the same id, only the row with the most recent effectiveTime is imported into the snapshot.

   **Caution:** Only take account of the id and effectiveTime fields when determining which rows to import into a snapshot. A common mistake is to look for the most recent active row. This results in serious errors. The active field should only be considered after importing the data and then provides information on whether that component is or is not active as part of the snapshot.
Option 2. Filter current full release to create current snapshot view

For each component only include the component-version with the most recent effectiveTime

Note: Option 2 can also be used to create an earlier snapshot view. To do this only import rows that represent the most recent version of each component with an effectiveTime that is no later that the time of the required snapshot.

Tip: The files that form part of a particular release can be identified by pattern matching based on the IHTSDO filenaming conventions (see Identifying release files using regular expressions).

7.2.1.3.2 Updating a Snapshot view

A snapshot view can be updated by one of the following approaches:

1. Use a set of delta release files to update the a snapshot view of the previous version:
   - The overall process can be described as follows:
     - Append the delta release to the previous snapshot;
     - Filter to remove rows that have the same id so that only the row with the most recent effectiveTime remains.
   - An efficient way to achieve this end result is to take account of the fact that the most recent version of any given component will be in the new delta release rather than in the previous version of the snapshot view.
Figure 91: Updating a snapshot view using a delta release

Figure 92: Updating a snapshot view using a full release
Tip: The files that form part of a particular release can be identified by pattern matching based on the IHTSDO filenaming conventions (see Identifying release files using regular expressions).

### 7.2.1.3.3 Importing and updating Extensions for a Snapshot view

To provide access to the snapshot view of one or more Extensions, a terminology server must initially import or create the current snapshot for each required Extension. This can be done either using snapshot release files or full release files as described for importing a Snapshot view. Thereafter, the snapshot view of each Extension can be maintained by using any of the techniques described for updating a Snapshot view.

When a snapshot view of Extension data is initially imported or subsequently updated care needs to be taken to ensure the relevant versions of the International Release and any other Extensions on which it depends have also been imported or updated. Failure to follow this will lead to errors as a result of references from Extension components to missing or out of date components in the International Release or in another Extension.

For all normal uses the snapshot view of an Extension version must be combined with the snapshot view of the versions of the International Release on which it was based. Similarly, if an Extension is dependent on another Extension, the snapshot of the Extension on which it depends must be for the version on which the dependent Extension version was based.

The table below summarises the compatibility between the snapshot views of given versions of an Extension and the International Release. It also identifies some limited cases in which a snapshot view may be used when not directly compatible with the relevant International Release snapshot. If one Extension depends on another Extension, the same considerations apply to compatibility between the versions of those Extensions.
Table 195: Compatibility between snapshot views of versions of an Extension and the International Release

<table>
<thead>
<tr>
<th>Relationship between the version of the Extension and the International Edition</th>
<th>Notes on compatibility and usability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed International Release is older than the version on which the Extension was based</td>
<td>Incompatible. The Extension may include Relationships to concepts that do not exist in this version of the International Release. This will lead to errors that cannot be reconciled while viewing the Extension content. Excluding components that conflict in this way results in other errors the previous state of the Extension content is not available in a snapshot view. A system with this mix of snapshot versions cannot be safely used.</td>
</tr>
<tr>
<td>Installed International Release is same version as the one on which the Extension was based</td>
<td>Full compatible. This is the version the Extension was created for so it should behave as intended.</td>
</tr>
</tbody>
</table>
| Installed International Release is newer than the version on which the Extension was based. | Partially compatible - subject to appropriate configuration and usage. The International Edition for this version may include:  
- Additional components. These will not cause errors because the International Release does not reference the Extension and the Extension content cannot reference components that did not exist when in the version it was based on.  
- Changes to the state of some components. These changes may affect the interpretation of some parts of the Extension.  
In a snapshot view the International Release cannot be rolled back to its previous state and, as a result, cannot be aligned with the version on which the Extension was based. Therefore, the potential for safe use of combinations of this is limited to the following:  
1. Configured to exclude the Extension. In this case the most recent snapshot of the International Release can be viewed. The incompatible Extension is ignored.  
2. Configured to use those parts of the Extension that support translation of International Release content. In this case, the Extension will enable translated rendering of pre-existing translated content. This would leave new and untranslated concepts to be rendered in English (or another available language). |

Note: A full view implementation can be configured to be more tolerant to different versions of installed Extensions and International Releases. In effect the full view allows virtual snapshots of the state of each Extension to be used to deliver a compatible set of component-versions.

7.2.1.4 Maintaining a Multi-snapshot view

If more than one snapshot view is required, the most effective approach is to implement a full view that enables a dynamic snapshot to be provided for any chosen time. The alternative approach is to create several separate snapshot views and to allow users to choose and where necessary switch between these static snapshots.
Each of these views in a multi-snapshot view is separately created and maintained in the same way as a single snapshot view. The required view for a particular purpose is selected from those available in the server. Where necessary more than one view may be selected to identify changes between versions.

In the long-term this approach requires more maintenance effort and more storage space than a full view and is far less flexible. It assumes a small set of discrete views such as those that arise from a relatively infrequent releases of SNOMED CT content. A more gradual evolution of content may occur in future as a result of the additions to Extensions and the ability to distribute delta releases. The multiple-snapshot approach may still meet the limited requirements of an organisation needing access to two or three specified snapshot views (e.g. for current, previous and perhaps one other defined reference date). This approach may be useful as an interim measure in an environment that is unable to provide adequate performance for dynamic snapshot views.

7.2.2 Choosing the release files to import

The International Release files to be imported should all be selected from the set of files representing a single Release Type for a chosen version of the SNOMED CT International Release.

Within the chosen file set the files identified in Table 196 must be imported. The files listed in Table 197 should also be imported as these provide important information about inactive concepts and metadata about Description types. The decision on whether to import the files listed in Table 198 depends on whether the additional features identified in that table are required for the planned implementation. Finally the supplementary files listed in Table 199 may be used to assist implementation but are not essential as the data they contain can be generated from the other files and/or replaced by alternative approaches to provide similar functionality.

<table>
<thead>
<tr>
<th>Table 196: Mandatory import files</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File type</strong></td>
</tr>
<tr>
<td>sct2_concept_[rt]_INT...</td>
</tr>
<tr>
<td>sct2_description_[rt]_INT...</td>
</tr>
<tr>
<td>sct2_relationship_[rt]_INT...</td>
</tr>
<tr>
<td>sct2_cRefset_Language [rt]- [lang]_INT...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 197: Highly recommended import files</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File type</strong></td>
</tr>
<tr>
<td>der2_cRefset_AttributeValue [rt]_...</td>
</tr>
<tr>
<td>der2_cRefset_DescriptionType [rt]_INT...</td>
</tr>
<tr>
<td>der2_cRefset_AssociationReference [rt]_INT...</td>
</tr>
</tbody>
</table>
### Table 198: Optional import files

<table>
<thead>
<tr>
<th>File type</th>
<th>Content</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>der2_sRefset_SimpleMap [rt] _INT...</td>
<td>Maps from NHS Clinical Terms Version 3 codes, other Read Codes to SNOMED CT</td>
<td>Only required if the server needs to be able to lookup SNOMED CT concepts based on a CTV3 Identifier or Read Code.</td>
</tr>
<tr>
<td></td>
<td>Maps from legacy SNOMED CT3 codes to SNOMED CT</td>
<td>Only required if the server needs to be able to lookup SNOMED CT concepts based on a legacy SNOMED CT3 code.</td>
</tr>
<tr>
<td>WordEquivalents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>StatedRelationships</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 199: Supplementary import files

<table>
<thead>
<tr>
<th>File type</th>
<th>Content</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>DescWordKey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DescDualKey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ExcludedWords</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TransitiveClosure</td>
<td>Generated from the Relationships. Needs to be regenerated or updated if Extensions are imported.</td>
<td></td>
</tr>
</tbody>
</table>

If Extensions are required to support an implementation, the release files to be imported should be selected from the set of files for a single Release Type for a chosen version of that Extension. It is important to ensure that the International Release version(s) on which all the imported Extensions are based has also been imported. The files that need to be imported from a chosen Extension may vary depending on the scope of the Extension.

**Note:** Advice should be sought from the Extension provider on the essential and recommended requirements of files to be imported and supported.

### 7.2.3 Choosing extension files to import

The process of importing an Extension is similar to importing the main distribution files. However, some additional functionality is required to ensure appropriate installation, maintenance and use of Extensions.

Applications should:

- Allow the users or user communities to specify the Extensions to be recognised by their systems. Before recognising any Extension, users should check that:
  - The Extension has been supplied by the IHTSDO or another organisation authorised by the IHTSDO to provide such Extensions.
  - You are satisfied with the quality control procedures of the providing organisation:
• Authorisation of an organisation to produce Extensions does not imply any seal of approval related to the quality of Extensions provided by those organisations;
• Installation of Extensions is done entirely at the risk of the user subject to their licence agreement with the provider of the Extension and/or the application developer.

7.2.4 Identifying release files using regular expressions

The files that form part of each release follow IHTSDO file naming conventions. These conventions allow the files that form part of a particular Release Type, version or extension to be identified by pattern matching. The following tables include examples of standard regular expressions that selectively match particular sets of release files.
Table 200: General patterns for Release Types

<table>
<thead>
<tr>
<th>Release</th>
<th>Type</th>
<th>Regular Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>full</td>
<td>^x?(sct</td>
</tr>
<tr>
<td>International</td>
<td>delta</td>
<td>^x?(sct</td>
</tr>
<tr>
<td>International</td>
<td>snapshot</td>
<td>^x?(sct</td>
</tr>
<tr>
<td>Any Extension</td>
<td>full</td>
<td>^x?(sct</td>
</tr>
<tr>
<td>Any Extension</td>
<td>delta</td>
<td>^x?(sct</td>
</tr>
<tr>
<td>Any Extension</td>
<td>snapshot</td>
<td>^x?(sct</td>
</tr>
<tr>
<td><strong>Release</strong></td>
<td><strong>Regular Expression</strong></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>^x?(sct</td>
<td>der</td>
</tr>
<tr>
<td>Type: full</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version: 2010-07-31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>^x?(sct</td>
<td>der</td>
</tr>
<tr>
<td>Type: full</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version: 2011-01-31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Member Extension</td>
<td>^x?(sct</td>
<td>der</td>
</tr>
<tr>
<td>Type: full</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country: GB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Namespace: 1000001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version: 2011-04-01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affiliate Extension</td>
<td>^x?(sct</td>
<td>der</td>
</tr>
<tr>
<td>Type: full</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Namespace: 1000003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version: 2011-07-31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.2.5 Checking during the import process

The import process should check the imported data to confirm that:

- The distribution files imported are all part of the same release.
- The set of files imported is complete and includes all mandatory components.
- In the case of a delta release, the data previously imported is the version immediately prior to the delta release being imported.
- In the case of a snapshot or full release, pre-existing data has been removed:
  - Alternatively the import process may be configured to overwrite duplicate rows so that:
    - The end result of a snapshot import does not contain any obsolete rows;
    - The end result of a full release import is identical to the content of the full release.

- All component Identifiers have:
  - A partition identifier appropriate to the type of component;
  - A valid check-digit.

- All fields meet data type, size and value constraints specified for the relevant tables.

Other consistency checks may also be applied to ensure the integrity of the data.

7.2.5.1 Additional checks when importing Extensions

The process of importing an Extension is similar to importing the main distribution files. However, some additional functionality is required to ensure appropriate installation, maintenance and use of Extensions. Applications should:

Check each Extension prior to installation to ensure that:

- It is one of the Extensions recognised by the user.
- It is supported by or based on the currently installed International Release version.
- The required versions of other Extensions on which this Extension depends have already been installed (or have been selected for installation as part of the same import process).
- Any dependencies of the Extension have been met. These dependencies may include:
  - Installation of a particular SNOMED CT release;
  - Prior installation of other Extensions.

**Note:** Dependencies are represented using the moduleId and the Module Dependency Reference Set.

- The installation procedure has pre-checked all components in the Extension to ensure that:
  - All Component Identifiers:
    - Are unique;
    - Have a partition identifier appropriate to the type of component;
    - Have a namespace Identifier appropriate to the provider of that Extension
    - Have a valid check-digit
  - All fields meet data type, size and value constraints specified for the relevant tables.

**Caution:** If any components fail any of these tests the entire Extension must be rejected. Rejecting individual components is liable to lead to inconsistent data. Accepting data that fails these test may create conflicts between different Extensions or between the Extension and the International release.

- Reject, highlight or apply other agreed business rules to information received by the system that contains SCTIDs for components from namespaces that are not in the list, or recognised Extensions.
7.2.6 Pre-processing of distribution files by terminology server suppliers

The import process may be time-consuming due to the need to build indices or other data structures. It may also require substantial spare storage capacity for temporary files. Therefore a terminology server provider may choose to pre-import the distribution files and provide them to users in pre-prepared form. However, an import facility should also be available in a suitably secured form to end-user organisations, to enable installation and maintenance of locally required Extensions.

7.3 Implementing Dynamic Snapshot Views

A key feature of SNOMED CT Release Format 2 is that it allows a single database table to represent the full view of a SNOMED CT component. This view includes all versions of the component from its first release up to its state in the latest release. This offers several significant benefits which are described elsewhere in the guide.

Most frequently used SNOMED CT functions need to provide access to a 'snapshot' view of the content of SNOMED CT at a point in time.

- Everyday use of SNOMED CT for data entry and retrieval will generally require a current 'snapshot' view.
  
  **Example:** To see the active content of SNOMED CT including all the most up to date components and excluding any components that have been marked as inactive.

- There are some situations in which a retrospective 'snapshot' view of the data at a selected point in the past is required.
  
  **Example:**
  To see the definition of a concept as it was when a record entry was created.
  To see the version of the International Release on which the latest available version of an Extension was based.

7.3.1 Generating Dynamic Snapshot Views

The general method for creating a snapshot 'view' for a specified SnapshotTime is as follows:

1. Exclude all Component versions with an effectiveTime greater than the SnapshotTime.

  **Note:** In theory the most recent snapshot view step could be omitted. However, a release will often be distributed before its effectiveTime. Therefore, this approach is not recommended as a general approach in a live system.

2. From each set of Component versions with the same id select the Component version with the highest (most recent) effectiveTime.

The most flexible approach is to apply this method dynamically so that a different snapshot time can be configured as needed to meet new requirements. The following example code illustrates an implementable approach to this.

```sql
SELECT `c`.* FROM `sct2_concept` AS `c`
WHERE `c`.effectiveTime = (SELECT MAX(`c2`.effectiveTime)
FROM `sct2_concept` `c2`
WHERE `c2`.id = `c`.id
AND `c2`.effectiveTime <= `snapshotTime`())
```

**Figure 94: General form of SQL to create a snapshot view**

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In this sample code `snapshotTime()` is a function that returns the time to be applied to this snapshot. For the most recent snapshot view this can be omitted as shown below:

```sql
SELECT `c`.* FROM `sct2_concept` AS `c`  
WHERE `c`.:effectiveTime = (SELECT MAX(`c2`.:effectiveTime)  
FROM `sct2_concept` AS `c2`  
WHERE `c2`.:id = `c`.:id)
```

**Figure 95: SQL to create the latest snapshot view**

Similar views can be created for each of the Component tables by simply replacing the table name in both the outer and nested queries.

**Note:** The SQL queries in this and the following section assume applicability of a common versioning view for all modules. In some cases, where a module that is being used depends on an earlier version of another module, more complex queries and optimizations may be needed. For further information about how dependencies between module are represented see details of the Module dependency reference set.

### Optimising Dynamic Snapshots Views

Some databases may be able to generate dynamic snapshot views sufficiently rapidly to enable real time use. However, in other cases, even if the nested queries used in the general snapshot views work quickly on their own, more complex queries involving joins between different component tables may lead to performance degradation. There are several approaches that can be taken to optimising performance and two of these are in the following subsections.

#### Optimising using a Snapshot View Flag

The first optimisation approach is provide a simple way to optimise the current snapshot and can be extended to cover a limited number of additional snapshot views. A column is added to each component table to hold a boolean value that indicates whether or not a particular row is part of the current snapshot. In the following Description and example this added column is called `inSnapshot` and is referred to as a "snapshot view flag".

After importing or updating SNOMED CT content the snapshot view flag is updated using the results of a snapshot view query such as one illustrated in Figure 96. The example uses an intermediate temporary table. In some relational database environments nested queries could be used to reduce the number of steps in the script. However, the longer form is used here as some environments do not work (or are unpredictable) when updating a table that is also referenced by a nested select query.

```sql
/* Clear the inSnapshot flag */
UPDATE `sct2_concept` SET `inSnapshot`=False;
/* Create temporary table to hold latest id+effectiveTime */
DROP TEMPORARY TABLE IF EXISTS `tmp_ids`;
CREATE TEMPORARY TABLE `tmp_ids` (`id` BIGINT,`effectiveTime` DATETIME, PRIMARY KEY (`id`));
/* replace the line above with the line below for Refsets as the Id is a UUID rather than SCTID */
/* CREATE TEMPORARY TABLE `tmp_ids` (`id` BINARY(16),`effectiveTime` DATETIME, PRIMARY KEY (`id`)); */
/* Populate the temporary table with id+effectiveTime for the latest view*/
INSERT INTO `tmp_ids` (`id`, `effectiveTime`) FROM `sct2_concept` AS `c`  
WHERE `c`.:effectiveTime = (SELECT MAX(`c2`.:effectiveTime)  
FROM `sct2_concept` AS `c2`  
WHERE `c2`.:id = `c`.:id);
/* Use the temporary table to update the inSnapshot flag for relevant rows */
UPDATE `sct2_concept` AS `c`, `tmp_ids` AS `t`  
SET  
`inSnapshot` = True  
WHERE `c`.:id = `t`.:id AND `c`.:effectiveTime = `t`.:effectiveTime;
```
/* Clean up by removing the temporary table */
DROP TEMPORARY TABLE `tmp_ids`;

Figure 96: Setting the latest snapshot view flag

The following query illustrates the simple query that can be used to return the current snapshot view using the snapshot view flag.

```
SELECT `c`.* FROM `sct2_concept` AS `c` WHERE `c`.`inSnapshot` = True;
```

Figure 97: Using a snapshot view flag to select components in a snapshot view

The same approach can be applied to each of the components by replacing `sct2_concept` with the relevant table name.

Additional snapshot view flags can be added, set and used in a similar way for a few other snapshot times that need to be optimised.

/* Clear the inSnapshotPrev flag */
UPDATE `sct2_concept` SET `inSnapshotPrev`=False;

/* Create temporary table to hold latest id+effectiveTime */
DROP TEMPORARY TABLE IF EXISTS `tmp_ids`;
CREATE TEMPORARY TABLE `tmp_ids` (`id` BIGINT, `effectiveTime` DATETIME, PRIMARY KEY (`id`));

/* replace the line above with the line below for Refsets as the Id is a UUID rather than SCTID */
/* CREATE TEMPORARY TABLE `tmp_ids` (`id` BINARY(16), `effectiveTime` DATETIME, PRIMARY KEY (`id`));

/* Populate the temporary table with id+effectiveTime for the specified view date time */
INSERT INTO `tmp_ids` SELECT `id`,`effectiveTime` FROM `sct2_concept` AS `c`  
   WHERE `c`.`effectiveTime` = (SELECT MAX(`c2`.`effectiveTime`)  
   FROM `sct2_concept` AS `c2`  
   WHERE `c2`.`id` = `c`.`id` AND `c2`.`effectiveTime` <= CAST('2010-01-31', DATETIME));

/* Use the temporary table to update the inSnapshotPrev flag for relevant rows */
UPDATE `sct2_concept` AS `c`,`tmp_ids` AS `t`  
   SET  
      `inSnapshotPrev` = True  
   WHERE `c`.`id`=`t`.`id` AND `c`.`effectiveTime` = `t`.`effectiveTime`;

/* Clean up by removing the temporary table */
DROP TEMPORARY TABLE `tmp_ids`;

Figure 98: Setting the snapshot view flag for a specified date

This approach provides a simple approach to optimisation of a limited number of views. However, it is constrained by the need to allocate a column for each time for which an optimised snapshot view is required.

Optimising using a Superseded Time

This approach to optimisation of dynamic snapshot views uses a single additional column in each component table to denote the time at which a row was superseded by a new version of the same component. This is more flexible but may not deliver the same performance improvement as the snapshot view flag approach.

After importing or updating SNOMED CT content the superseded time values are checked and updated where relevant using a query such as one illustrated in Figure 99. In this example, a fixed distant future date (31-12-9999) is used for Components which have not been superseded. The alternative would be a null date but the fixed distant date avoids the need to look for null as an exception at runtime. It also allows additional optimisation of the current view - particularly if the supersededTime is indexed.

/* Create temporary table to hold latest id+effectiveTime */
DROP TEMPORARY TABLE IF EXISTS `tmp_supersede`;
CREATE TEMPORARY TABLE `tmp_supersede` (`id` BIGINT, `effectiveTime` DATETIME, `supersededTime` DATETIME, PRIMARY KEY (`id`, `effectiveTime`));
/* replace the line above with the line below for Refsets as the Id is a UUID rather than SCTID */
/* CREATE TEMPORARY TABLE `tmp_supersede` (id BINARY(16), effectiveTime DATETIME, supersededTime DATETIME, PRIMARY KEY (id, effectiveTime)); */

/* Populate the temporary table with id+effectiveTime+supersededTime */
INSERT INTO `tmp_supersede`
  SELECT `c`.
  FROM `sct2_concept` AS `c`

/* Use the temporary table to update the supersededTime flag for relevant rows */
UPDATE `sct2_concept` AS `c` JOIN `tmp_supersede` AS `t`
  ON `c`.

/* Clean up by removing the temporary table */
DROP TEMPORARY TABLE `tmp_supersede`;

Figure 99: Populating or updating the superseded time after importing content

Figure 100 illustrates the general query for returning the snapshot view for a specified time. To be included in the view the effectiveTime must be the same as or before the snapshot time and the supersededTime must be after the snapshot time.

SELECT `c`.

Figure 101: Using the superseded time to select components in the current snapshot view

The same approach can be applied to each of the Components by replacing `sct2_concept` with the relevant table name.

7.4 Working with metadata

SNOMED CT RF2 files represent some key information about core release components by reference to other SNOMED CT components. Two types of metadata (Concept Enumerations and Reference Sets) are described in the following sections:

- **Concept Enumerations** provide sets of values for enumerated fields in SNOMED CT components.
- **Reference Sets** support a wide range of functions and the following section subdivide these functions according their relative importance:
  - **Essential Reference Sets**;
  - **Optional Reference Sets**;
  - **Reference Sets supporting advanced functionality**.
### 7.4.1 Concept enumerations

*SNOMED CT* core components have some fields that have values represented by concepts in specific parts of the *SNOMED CT* hierarchy. These are referred to as concept enumerations.

The range of permitted values for each of the concept enumerations is the set of subtypes of a specified concept which is itself a subtype of 900000000000442005 | Core metadata concept (core metadata concept) |. The current set of concept enumeration types is shown in Table 202. The values of each of these and the ways they should be used in implemented systems are described in the following subsections.

**Table 202: Core metadata concept (core metadata concept) (900000000000442005)**

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000443000</td>
<td>Module (core metadata concept)</td>
<td>Each subtype of this concept represents a development module. These concepts provide values to the moduleId field that is present in all <em>SNOMED CT</em> component file. The value indicates the module within which a component was created and is being maintained.</td>
</tr>
<tr>
<td>900000000000444006</td>
<td>Definition status (core metadata concept)</td>
<td>Each subtype of this concept represents a value that can be applied to the concept. definitionStatusId field. This is used to indicate whether the current set of defining Relationships applied to a concept are sufficient to fully-define it relative to its supertypes.</td>
</tr>
<tr>
<td>900000000000446008</td>
<td>Description type (core metadata concept)</td>
<td>Each subtype of this concept represents a value that can be applied to the Description.typeId field. This is used to indicate whether the Description represents a Fully Specified Name, a synonymous term, a definition or some other symbolic or textual representation of the associated concept.</td>
</tr>
<tr>
<td>900000000000447004</td>
<td>Case significance (core metadata concept)</td>
<td>Each subtype of this concept represents a value that can be applied to the Description.caseSignificanceId field. This is used to indicate whether the text of the term can be modified to by switching characters from upper to lower case (or vice-versa).</td>
</tr>
<tr>
<td>900000000000449001</td>
<td>Characteristic type (core metadata concept)</td>
<td>Each subtype of this concept represents a value that can be applied to the Relationship.characteristicTypeId field. This is used to indicate whether a Relationship forms part of the definition of the source concept.</td>
</tr>
</tbody>
</table>
Each subtype of this concept represents a value that can be applied to the Relationship.modifierId field. This is used to indicate the type of Description Logic (DL) restriction (some, all, etc.) that applies to the Relationship.

Each subtype of this concept represents a value that can be applied to the Identifier.identifierSchemeId field. This is used to indicate the scheme to which the Identifier value belongs.

Note: Many of the concept enumerations include values that significantly impact the meaning or use of a component. Therefore, implementers may find it necessary to partially hard-code the way their systems process particular values. In these cases, the concept referenced by the value is only of value when there is a requirement to display a human readable rendering of the value. The main exceptions to this are 900000000000443000 | Module (core metadata concept) | and 900000000000453004 | Identifier scheme (core metadata concept) | both of which represent extensible sets of values as new modules or alternative Identifier schemes may be added in local Extensions.

7.4.1.1 Concept enumerations for moduleId

This concept enumeration applies to the moduleId field which is present in all released SNOMED CT components (RF2). The value applied to a particular component indicates the development module within which that component was created and is being maintained.

Each of the values in Table 203 represents a development module. The range of permitted list of values is extensible by addition of branches to the hierarchy shown in Figure 102 modules managed by other organisations (i.e. in an extensions namespace) and to add specific module Identifiers within each branch.

Table 203: International Health Terminology Standards Development Organisation maintained module (core metadata concept) (900000000000445007)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000012004</td>
<td>SNO MED CT model component module (core metadata concept)</td>
<td></td>
</tr>
<tr>
<td>9000000000000207008</td>
<td>SNO MED CT core module (core metadata concept)</td>
<td></td>
</tr>
</tbody>
</table>

- 9000000000000443000 | Module (core metadata concept) |
- 9000000000000445007 | International Health Terminology Standards Development Organisation maintained module (core metadata concept) |
  - 900000000000012004 | SNO MED CT model component module (core metadata concept) |
  - 9000000000000207008 | SNO MED CT core module (core metadata concept) |

Figure 102: Hierarchy of SNOMED CT moduleId values
7.4.1.2 Concept enumerations for definitionStatusId

This concept enumeration represents a value that can be applied to the definitionStatusId field. This is used to indicate whether the current set of defining Relationships applied to a concept are sufficient to fully-define it relative to its supertypes.

Table 204 shows the current set of values for this concept enumeration.

Table 204: Definition status (core metadata concept) (9000000000000444006)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000073002</td>
<td>Sufficiently defined concept definition status (core metadata concept)</td>
<td>The set of defining Relationships applied to the concept are asserted to fully define the concept. Any concept or expression for which all these defining Relationships are true is either equivalent to or subsumed by this concept. Any concept or expression for which any of these defining Relationships is not true is neither equivalent to nor subsumed by this concept.</td>
</tr>
</tbody>
</table>

| 900000000000074008 | Necessary but not sufficient concept definition status (core metadata concept) | The set of defining Relationships applied to the concept are asserted to be incompletely define the concept. The concept is currently considered to be primitive. A concept or expression for which all these defining Relationships are true may be equivalent to or subsumed by this concept. However, it is not possible to compute this from the definition - because the missing element in the definition may or may not apply to the other concept or expression. Any concept or expression for which any of these defining Relationships is not true is neither equivalent to nor subsumed by this concept. |

7.4.1.3 Concept enumerations for Description typeId

This concept enumeration represents a value that can be applied to the Description typeId field. This is used to indicate whether the Description represents a Fully Specified Name, a synonymous term, a definition or some other symbolic or textual representation of the associated concept.

Table 205 shows the current set of values for this concept enumeration.
Table 205: Description type (core metadata concept) (9000000000000446008)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000003001</td>
<td>Fully specified name (core metadata concept)</td>
<td>The Description.term represents the Fully Specified Name of the associated concept in the language indicated by the Description.languageCode.</td>
</tr>
<tr>
<td>900000000000013009</td>
<td>Synonym (core metadata concept)</td>
<td>The Description.term represents a term that is used to represent the associated concept in the language indicated by the Description.languageCode. Note: The preferred term used in a given language or dialect is marked as a synonym. Preference and acceptability of a particular synonymous term is indicated by a Language refset.</td>
</tr>
<tr>
<td>900000000000550004</td>
<td>Definition (core metadata concept)</td>
<td>The Description.term represents a textual definition of the associated concept in the language indicated by Description.languageCode.</td>
</tr>
</tbody>
</table>

7.4.1.4 Concept enumerations for caseSignificanceId

This concept enumeration represents a value that can be applied to the Description.caseSignificanceId field. This is used to indicate whether the text of the term can be modified to by switching characters from upper to lower case (or vice-versa).

Table 206 shows the current set of values for this concept enumeration.

Table 206: Case significance (core metadata concept) (9000000000000447004)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000017005</td>
<td>Entire term case sensitive (core metadata concept)</td>
<td>The text of the Description.term must be presented in the case in which it is specified.</td>
</tr>
<tr>
<td>90000000000020002</td>
<td>Only initial character case insensitive (core metadata concept)</td>
<td>The initial character of the Description.term is case insensitive and can be changed from upper to lower case (or vice-versa) if appropriate to the context in which it is used. This applies only to the first character of the term as a whole, not to the initial character of other words in the term.</td>
</tr>
<tr>
<td>9000000000048009</td>
<td>Entire term case insensitive (core metadata concept)</td>
<td>The entire Description.term is case insensitive and can be can be changed from upper to lower case (or vice-versa) if appropriate to the context in which it is used.</td>
</tr>
</tbody>
</table>
7.4.1.5 Concept enumerations for characteristicTypeId

This concept enumeration represents a value that can be applied to the Relationship. characteristicTypeId field. This is used to indicate whether a Relationship forms part of the definition of the source concept.

Table 207 shows the current set of values for this concept enumeration. Note that two the values 900000000000010007 | Stated relationship (core metadata concept) | and 900000000000011006 | Inferred relationship (core metadata concept) | are subtypes of the more general value 900000000000006009 | Defining relationship (core metadata concept) |.

Table 207: Characteristic type (core metadata concept) (900000000000449001)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>90000000000006009</td>
<td>Defining relationship (core metadata concept)</td>
<td>The Relationship is part of the description logic definition of the source concept.</td>
</tr>
<tr>
<td>- 90000000000010007</td>
<td>Stated Relationship (core metadata concept)</td>
<td>Indicates that this defining Relationship was stated by a terminology author.</td>
</tr>
<tr>
<td>- 90000000000011006</td>
<td>Inferred Relationship (core metadata concept)</td>
<td>Indicates that this defining Relationship was inferred by a description logic classifier from the set of stated Relationships.</td>
</tr>
<tr>
<td>900000000000225001</td>
<td>Qualifying relationship (core metadata concept)</td>
<td>The Relationship is not part of the definition of the concept but indicates a possible qualification that may be applied to refine a postcoordinated expression that refers to the source concept.</td>
</tr>
<tr>
<td>900000000000227009</td>
<td>Additional relationship (core metadata concept)</td>
<td>The Relationship is not part of the definition of the concept but is used to convey some additional information about the concept. This additional information may only be applicable to a particular jurisdiction or use case.</td>
</tr>
</tbody>
</table>

7.4.1.6 Concept enumerations for modifierId

This concept enumeration represents a value that can be applied to the Relationship.modifierId field. This is used to indicate the type of Description Logic (DL) restriction (some, all, etc.) that applies to the Relationship.

Table 208 shows the current set of values for this concept enumeration.

Table 208: Modifier (core metadata concept) (900000000000450001)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000451002</td>
<td>Existential restriction modifier (core metadata concept)</td>
<td>Indicates that description logic restriction represented by this defining Relationship applies to some aspect of the concept.</td>
</tr>
</tbody>
</table>
7.4.1.7 Concept enumerations for identifierSchemaId

This concept enumeration represents a value that can be applied to the Identifier. identifierSchemaId field. This is used to indicate the scheme to which the Identifier value belongs.

Table 209 shows the current set of values for this concept enumeration. This set of values is extensible to allow additional Identifiers to be used to represent SNOMED CT components where this is necessary.

Table 209: Identifier scheme (core metadata concept) (900000000000453004)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000452009</td>
<td>Universal restriction modifier (core metadata concept)</td>
<td>Indicates that description logic restriction represented by this defining Relationship applies to all aspects of the concept.</td>
</tr>
<tr>
<td>900000000000294009</td>
<td>SNOMED CT universally unique identifier (core metadata concept)</td>
<td>The identification scheme in which the Identifiers are UUID's allocated to SNOMED CT components.</td>
</tr>
<tr>
<td>900000000000200006</td>
<td>SNOMED CT integer identifier (core metadata concept)</td>
<td>The scheme comprising all SNOMED Clinical Terms Identifiers (SCTID).</td>
</tr>
</tbody>
</table>

7.4.1.8 Other Concept enumerations

Reference sets can also include concept enumeration values and the values for these are subtypes of 900000000000491004 | Attribute value (foundation metadata concept) |. The values applicable to each Attribute in each type of Reference set are specified by the 900000000000456007 | Reference set descriptor reference set (foundation metadata concept) |.

Note: In the current pre-release RF2 data some sets of concept enumerations are subtypes of 900000000000457003 | Reference set attribute (foundation metadata concept) |. However, in future it is anticipated that they will all be subtypes of 900000000000491004 | Attribute value (foundation metadata concept) |.

7.4.2 Essential Reference Sets

The Reference Set mechanism provides flexibility and extensibility to the core terminology. The Reference Sets described in this section are essential and need to be supported by all SNOMED CT enabled terminology servers.

Other Reference Sets are used to deliver specific added value functionality and/or for local configuration. While implementers are advised to consider providing full Reference Set support the specific requirements for these depend on the intended uses of the systems and these are described elsewhere in the guide.

7.4.2.1 Language Reference Sets

At least one language Reference Set needs to be imported. This is essential to enable the preferred term to be identified for each concept.

The language Refsets supported in the International Release are shown in Table 210.
The Language Reference Set hierarchy is extensible and other languages and dialects will be added to the hierarchy shown in Figure 103 to either as part of the International Release or an Extension.

Figure 103: The Language Reference Set hierarchy

Each language Reference set refers to each of the Descriptions that is used in that language or dialect and assigns a value for the acceptability of the term associated with that Description when applied to the Concept associated with that Description. The values for acceptability are concept enumerations show in Table 211.

Table 210: English [International Organization for Standardization 639-1 code en] language reference set (foundation metadata concept) (900000000000507009)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000508004</td>
<td>Great Britain English language reference set (foundation metadata concept)</td>
<td></td>
</tr>
<tr>
<td>900000000000509007</td>
<td>United States of America English language reference set (foundation metadata concept)</td>
<td></td>
</tr>
</tbody>
</table>

Table 211: Acceptability (foundation metadata concept) (900000000000511003)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
</table>
| 900000000000548007  | Preferred (foundation metadata concept) | The term associated with this description is the preferred description, of the specified Description.type, for the associated concept, in the language or dialect represented by this Reference set.
|                     |                                                                      | • If the Description.type is synonym, this description is the preferred term.  
|                     |                                                                      | • If the Description.type is fully specified name this description is the preferred fully specified name.  
|                     |                                                                      | For each concept there should be exactly one preferred description of each Description.type in each language Reference set. |
The term associated with this description is acceptable for use in language or dialect represented by this Reference set. For each concept there may be any number of acceptable descriptions of each Description.type in each language Reference set.

7.4.2.2 Component Inactivation Reference Sets

The Component Inactivation Reference Sets are required to determine the reason why a concept, Description or Relationship is inactive. The boolean active field in each component indicates whether it is active but does not explain why a previously active component has been inactivated. The reason for inactivation may affect the way in which components that have been made inactive are dealt with when they have been used to create records, protocols or queries prior to inactivation.

The three Component Inactivation Reference Sets are shown in Table 212.

Table 212: Component Inactivation Reference Sets

<table>
<thead>
<tr>
<th>Id</th>
<th>Fully Specified Name</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000481005</td>
<td></td>
<td>Acceptable (foundation metadata concept)</td>
</tr>
</tbody>
</table>

Table 213: Concept inactivation value (foundation metadata concept) (900000000000481005)

<table>
<thead>
<tr>
<th>Id</th>
<th>Fully Specified Name</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000482003</td>
<td></td>
<td>Duplicate component (foundation metadata concept)</td>
</tr>
<tr>
<td>900000000000483008</td>
<td></td>
<td>Outdated component (foundation metadata concept)</td>
</tr>
</tbody>
</table>
The Concept has been made inactive because it is inherently ambiguous either because of an incomplete fully specified name or because it has several associated terms that are not regarded as synonymous or partial synonymous.

The Concept has been made inactive because it contains an error.

The Concept is of limited value as it contains classification categories such as 'Not Elsewhere Classified' which do not have a stable meaning within SNOMED CT. Until 2010 concepts with this status were regarded as active but since then they have been marked as inactive.

The Concept has been made inactive because it has been moved to another namespace.

The Concept is still active but it is in the process of being moved to another namespace and when the move is complete it will be marked as inactive.

<table>
<thead>
<tr>
<th>Id</th>
<th>Fully Specified Name</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>90000000482</td>
<td>Duplicate component (foundation metadata concept)</td>
<td>The Description has been made inactive because it duplicates another Description.</td>
</tr>
<tr>
<td>90000000483</td>
<td>Outdated component (foundation metadata concept)</td>
<td>The Description has been made inactive because it is an outdated name or spelling that is no longer used.</td>
</tr>
<tr>
<td>90000000485</td>
<td>Erroneous component (foundation metadata concept)</td>
<td>The Description has been made inactive because it contains an error.</td>
</tr>
<tr>
<td>90000000486</td>
<td>Limited component (foundation metadata concept)</td>
<td>The Description refers to a Concept that has limited status. Note: This value should not be used in future releases as Limited status Concepts are now inactive. However, this value may appear on retrospective data in a full release.</td>
</tr>
</tbody>
</table>

Table 214: Description inactivation value (foundation metadata concept) (9000000000000493001)
The component.active field allows rapid determination of whether a component is intended for active use. However, where a full interpretation of the status of a component is required two factors must be taken into account. The absence of a row in the relevant inactivation Refset implies a default meaning which and this default meaning depends on whether the component is active or inactive:

- For an active component it means active and in current use as distinct from active pending move
- For an inactive component it means inactive with no reason given for inactivation.

This leads to the set of interpretations for each possible combination of values shown in Table 215.

**Table 215: Concept Status evaluation table**

<table>
<thead>
<tr>
<th>Most recent Concept row for a concept.id</th>
<th>Most recent Refset row for the RefsetMember.id in “Concept inactivation Refset” for the concept.id</th>
<th>ConceptStatus (with RF1 enumerated value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exists/active</td>
<td>Exists/active</td>
<td>valueId</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>-</td>
</tr>
<tr>
<td>Active</td>
<td>None or Inactive</td>
<td>-</td>
</tr>
<tr>
<td>Inactive</td>
<td>None or Inactive</td>
<td>-</td>
</tr>
<tr>
<td>Inactive</td>
<td>Active</td>
<td>9000000000000482003</td>
</tr>
<tr>
<td>Inactive</td>
<td>Active</td>
<td>9000000000000483008</td>
</tr>
<tr>
<td>Inactive</td>
<td>Active</td>
<td>9000000000000484002</td>
</tr>
<tr>
<td>Inactive</td>
<td>Active</td>
<td>9000000000000485001</td>
</tr>
<tr>
<td>Inactive</td>
<td>Active</td>
<td>9000000000000486000</td>
</tr>
</tbody>
</table>
### 7.4.2.3 Historical Association Reference Sets

Historical Association Reference Sets provide links between inactive concepts and their active replacements or equivalents. There is one Historical Association Reference Set for each type of historical association as shown in Table 216.

#### Table 216: Historical association reference set (foundation metadata concept) (900000000000522004)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000523009</td>
<td>POSSIBLY EQUIVALENT TO association reference set (foundation metadata concept)</td>
<td>Applies to a concept that is ambiguous. The targetComponent is an active concept that represents one of the possible meanings of the inactive concept. Multiple rows are used to refer to each of the possible meanings of the ambiguous concept. Previously referred to as &quot;MAY BE A&quot;.</td>
</tr>
<tr>
<td>900000000000524003</td>
<td>MOVED TO association reference set (foundation metadata concept)</td>
<td>Applies to a component that has been moved to (or are pending a move to) another namespace. The targetComponent identifies the target namespace (not the new component).</td>
</tr>
<tr>
<td>900000000000525002</td>
<td>MOVED FROM association reference set (foundation metadata concept)</td>
<td>Applies to a component that has been moved to this namespace from another namespace. The targetComponent identifies the original component Identifier in its previous namespace.</td>
</tr>
<tr>
<td>900000000000526001</td>
<td>REPLACED BY association reference set (foundation metadata concept)</td>
<td>Applies to an erroneous, obsolete and other inactive component for which there is a single active replacement. The targetComponent identifies the active component that replaces this component.</td>
</tr>
</tbody>
</table>
### 7.4.2.4 Module Dependency Reference Set

The Module Dependency Reference Set provides information about dependencies between different versions of particular development modules. This Reference Set (identified as 900000000000534007 | Module dependency reference set (foundation metadata concept) | ) should be checked when importing data to ensure that all dependencies are satisfied.

The rows in this Reference Set that originate in a given module (identified by moduleId) indicate a dependency on the module identified by the referencedComponentId. The two string values each contain dates that indicate the version of source module and the required version of the module on which it depends.

### 7.4.3 Optional Reference Sets

The Reference Sets described in the following sections are required for specific purposes. If an implementation does not need to address a particular requirement (e.g. mapping from a legacy coding scheme) or supports a more up to date approach (e.g. the Machine Readable Concept Model rather than the use of refinability flags) then that Reference Set need not be imported or may be imported and not used.

#### 7.4.3.1 Legacy Code Map Reference Sets

Legacy Code Map Reference Sets are simple maps to SNOMED CT from legacy code systems, including SNOMED codes (i.e. codes used in SNOMED 3) and NHS Clinical Terms Version 3 Identifiers (including all versions of the Read Codes). There is one Reference Set for legacy SNOMED codes and one for Clinical Terms Version 3 as shown in Table 217.

In both cases, the referenceComponentId refers to a SNOMED CT concept and the mapTarget string value is the code in the other coding scheme.
### Table 217: Simple map type reference set (foundation metadata concept) (900000000000496009)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000497000</td>
<td>CTV3 simple map reference set (foundation metadata concept)</td>
<td>The map between Clinical Terms Version 3 and all version of the Read Codes and SNOMED CT.</td>
</tr>
<tr>
<td>900000000000498005</td>
<td>SNOMED RT identifier simple map (foundation metadata concept)</td>
<td>The map between legacy SNOMED codes and SNOMED CT.</td>
</tr>
</tbody>
</table>

### 7.4.4 Reference Sets supporting advanced functionality

Some of the Reference Sets included as part of the SNOMED CT International Release support advanced uses and may not need to be implemented. In particular Reference Sets that provide information about other Reference Set can be valuable but are not essential provided the implementation fully supports all the Reference Sets required by its users.

#### 7.4.4.1 Description Format Reference Set

The Description Format Reference Set provides information about the format of each of the Description types. This Reference Set is identified as 900000000000538005 | Description format reference set (foundation metadata concept) |

The referenced Component Id of each member of the reference set refers to a Description type, represented by a subtype of the concept 900000000000446008 | Description type (core metadata concept) |. The descriptionFormat refers to one of the Concept enumeration values shown in Table 218. The descriptionLength indicates the longest permitted string for this Description type.

### Table 218: Description format (foundation metadata concept) (900000000000539002)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000540000</td>
<td>Plain text (foundation metadata concept)</td>
<td>Descriptions of this types linked to this format are in plain text. This applies fully specified names and synonyms.</td>
</tr>
<tr>
<td>900000000000541001</td>
<td>Limited HyperText Markup Language (foundation metadata concept)</td>
<td>Descriptions of this types linked to this format use a limited version of HTML markup.</td>
</tr>
<tr>
<td>900000000000542008</td>
<td>Extensible HyperText Markup Language (foundation metadata concept)</td>
<td>Descriptions of this types linked to this format may use the full scope of XHTML markup.</td>
</tr>
<tr>
<td>900000000000543003</td>
<td>Darwin Information Typing Architecture (foundation metadata concept)</td>
<td>Descriptions of this types linked to this format are represented as DITA topics using XML markup.</td>
</tr>
</tbody>
</table>

#### 7.4.4.2 Reference Set Descriptor Reference Set

The Reference Set Descriptor Reference Set, which is identified as 900000000000456007 | Reference set descriptor reference set (foundation metadata concept) |, provides information about the structure of each type of Reference Set.
7.4.5 Using other Reference Sets

7.4.5.1 Importing Reference Sets

One or more Reference Sets may be held in a single Reference Set release file. However, if there are more than one Reference Sets in a single file, they will all have the same structure (i.e. - the same number of additional fields of the same top level types of component, Integer or String).

Each record in the Reference Set file represents a member of the reference set. The refsetId column identifies the Reference Set that the member record belongs to.

The refsetld can also be used to look up the concept in the Reference Set metadata that describes the reference set. Up to three Descriptions (with three different typeIds) may be associated with the Reference Set concept:

- A Description with a typeId of |FSN|, used to formally describe the Reference Set. This Description will always exist.
- A Description with a typeId of | Synonym |, used to name the Reference Set. This Description will always exist, and can be used to display the name of the Reference Set within a system.
- A Description with a typeId of |Purpose|, used to describe the purpose of the Reference Set. This Description may or may not be present.

The refsetld can also be used to look up the Reference Set Descriptor, in the Reference set descriptor|Reference Set. This can be done by identifying the member records in the Reference set descriptor|reference set with a referencedComponentId that matches the refsetld of the Reference Set.

There will be one Descriptor record describing the referencedComponentId field in the Reference Set and one additional record for each optional field within the Reference Set. The Descriptor record with an attributeOrder field value of ‘0’ describes the referencedComponentId field; a Descriptor record with an attributeOrder field value of ‘1’ would describe the first optional field; etc.

For each Reference set field being described (i.e. - the referencedComponentId and each optional field), two fields in the Descriptor record provide additional information:

- The attributeType field is a reference to a concept under the Attribute type| metadata hierarchy that provides typing information for the field. At the top level, this could be component type|, Integer | or String |, and would then match the typing information available within the Reference Set file name (see the SNOMED CT - File Naming Conventions). However, the type of a field can also be specified at a finer level of granularity using the attributeType field. For instance, instead of the attributeType being specified simply as an Integer |, it may instead be specified as an Signed integer | or a Unsigned integer |. For a full list of types, see the Attribute type| metadata hierarchy.
- The attributeDescription field is a reference to a concept under the Reference set attribute | metadata hierarchy that also provides additional information about each Reference Set field. Up to three Descriptions (with three different typeIds) may be associated with each of these concepts:
  - A Description with a typeId of |FSN|, used to formally describe the Reference Set field. This Description will always exist.
  - A Description with a typeId of | Synonym |, used to name the Reference Set field. This Description will always exist, and can be used to display a column header for each Reference Set field used within a system.
  - A Description with a typeId of |Purpose|, used to describe the purpose of the Reference Set field. This Description may or may not be present.

Additionally, if the attributeType is Concept type component |, then the children of the concept referred to by the attributeDescription provide a list of allowed concept enumeration values for the Reference Set field. Each of these concepts will have two Descriptions with typeIds of |FSN| and of | Synonym |, and the latter set of Descriptions can be used to validate field entry for concept enumeration type Reference Set fields or to create pick-lists to allow users to select one or more values. Where the attributeDescription concept does not have any children, then no limitation is placed on the concepts allowed in the Reference Set field.
7.4.5.2 Using Reference Sets without Descriptors

All Reference Sets that are released from IHTSDO or from a National Release Centre will have an associated Descriptor for the Reference Set. However, Descriptors are optional for other organisations that create Reference Sets. Where you are using a Reference Set for which a Descriptor has not been created, and you need additional information about the Reference Set, the Descriptor of the closest ancestor of the concept describing the Reference Set that does have a Descriptor may be used. This situation should be rare, as an organisation that releases Reference Sets should only release them without Descriptors if it is sure that its consumers do not require the information held within the Descriptors.

7.4.5.3 Using Reference Sets to hold simple value sets

Where it is known that a single simple Reference Set is held in a file, a simple value set may be retrieved from the Reference Set by taking the referencedComponentIds of each record with an active field set to ‘1’. Each value in the value set is then an SCTID of a SNOMED CT component.

Where a release file contains multiple simple Reference Sets, then a number of value sets may be retrieved from the file by taking the referencedComponentIds of each record with an active field set to ‘1’, and grouping them into value sets by using the refsetld field. Each value in the value set is an SCTID of a SNOMED CT component. In order to retrieve the name of each value set, its refsetld can be used to identify a | Reference set | metadata concept that will have a Description with a typeId of | Synonym | that provides a name for the value set.

7.5 Foundation Terminology services

This section summarises a set of services that all terminology servers require. Some of these services are described in more detail in subsequent sections. The more advanced services specified in other sections depend on one or more of these foundation services.

7.5.1 Access to release information

Terminology servers should enable client applications and users to access the current SNOMED CT release.

7.5.2 Access to components

Most Terminology services depend on the ability to efficiently access information about the set of components in a selected snapshot view. The following sections outline the types of information that need to be accessible and provide illustration of some of the common patterns of data access that are required. The illustrations are expressed as SQL queries based on the example relational representation and dynamic snapshot views approaches discussed in earlier sections.

7.5.2.1 Access to concepts

A terminology server should enable client applications to rapidly find the current version of a Concept by its unique Identifier (Concept.id).

Once a Concept has been found, the client application should be able to read the values of the properties of that Concept which are either:

1. Provided directly as concept file fields:
   - active;
   - definitionStatusId.

2. Provided indirectly through associations to other components:
   - Descriptions.
   - Relationships.
3. Provided indirectly via relevant Reference sets:
   • For example Information about Inactive Concepts.

7.5.2.1.1 Information about Inactive Concepts

The Concept.active field is a boolean value which distinguishes between active and inactive concepts. To find out more information about the status of a concept it is necessary to look for a relevant row in the 900000000000480006 | Attribute value type reference set (foundation metadata concept).

The example query below illustrates this process.

```sql
/* sv_concept refers to a snapshot view of concept */
/* sv_refset_status refers to a snapshot view of the */
/* inactivation Refset with term lookup see below */
SELECT `c`.`id` AS `ConceptId`,
(CASE WHEN (`r`.`RsActive` = 1) THEN
  `r`.`ValueTerm` else
  (CASE WHEN `c`.`active` THEN
    'Current' ELSE
    'Inactive no reason' END)
END) AS `Status`
FROM (`sv_concept` `c`
LEFT JOIN `sv_refset_status` `r`
ON (`r`.`ItemId` = `c`.`id`))
WHERE `c`.`id`=[some-concept-id];
```

Figure 104: Determining concept status

If a concept is inactive then, it may be necessary to follow the historical associations to locate the active concept(s) that have replaced or disambiguated the inactive concept. Figure 105 illustrates and finds the id of the active equivalent of a duplicate concept.

```sql
/* Find SAME AS reference for a duplicate concept */
/* sv_refset_c is snapshot view of the cRefset table */
SELECT `targetComponent`
FROM `sv_refset_c`
WHERE `refsetId`=900000000000527005
AND `referencedComponentId`=[some-concept-id];
```

Figure 105: Following historical associations

7.5.2.2 Access to Descriptions

A terminology server should enable client applications to rapidly find the current version of any Description or set of Descriptions by any of the following criteria:

• Its unique Identifier (Description.id);
• conceptId of the concept with which it is associated;
• A combination of conceptId, DescriptionType, Language or dialect and Acceptability (in that language or dialect).

Once a Description has been found the client application should be able to read the values of any of the properties of that Description which are either:
7.5.2.2.1 Determining Description Type and Acceptability

The active field indicates whether the Description is in current active use. The typeId and languageCode indicate the Description type and the language of the associated term. This information is useful but it is not sufficient to determine the preferred term. In order to determine the acceptability of or preference for use of a particular Description it is necessary to apply a language Reference set. This is illustrated by Figure 106.

/* sv_description is a snapshot view of the description file */
/* sv_refset_c is snapshot view of the cRefset table */
/* configLang() is a function that returns the chosen language RefsetId */

SELECT `d`.*
FROM (`sv_description` `d` join `sv_refset_c` `rs`
     ON((`d`.`id` = `rs`.`referencedComponentId`)))
WHERE ((`d`.`active` = 1) AND (`d`.`typeId` = 900000000000013009)
    AND (`d`.`conceptId`=[some-concept-id] AND (`rs`.`refsetId` = `configLangId`())
    AND (`rs`.`active` = 1) AND (`rs`.`valueId` = 900000000000548007));

Figure 106: Identifying the preferred term

The Fully Specified Name for a particular language or dialect can also be determined in the same way as shown in Figure 107. The only difference between this and the preferred term example is the change in the typeId predicate.

Note: The Fully Specified Name may not be present in all supported languages therefore a fall-back to the US English may be necessary.

SELECT `d`.*
FROM (`sv_description` `d` join `sv_refset_c` `rs`
     ON((`d`.`id` = `rs`.`referencedComponentId`)))
WHERE ((`d`.`active` = 1) AND (`d`.`typeId` = 900000000000003001)
    AND (`d`.`conceptId`=[some-concept-id] AND (`rs`.`refsetId` = `configLangId`())
    AND (`rs`.`active` = 1) AND (`rs`.`valueId` = 900000000000548007));

Figure 107: Identifying the preferred fully specified name

Figure 108 illustrates an approach to returning all the acceptable or preferred terms together with an indication of which Description type and preference.

/* sv_description is a snapshot view of the description file */
/* sv_refset_c is snapshot view of the cRefset table */
/* configLang() is a function that return the chosen language RefsetId */

SELECT `d`.*, (CASE WHEN `rs`.`valueId`=900000000000548007 THEN
    'Preferred' ELSE 'Acceptable' END) AS `Acceptability`
    (CASE WHEN `d`.typeId=900000000000013009 THEN
    'Synonym' ELSE 'FSN' END) AS `DescriptionType`
FROM (`sv_description` `d` join `sv_refset_c` `rs`
     ON((`d`.`id` = `rs`.`referencedComponentId`)))
WHERE ((`d`.`active` = 1) AND (`d`.typeId = 900000000000003001) OR (`d`.typeId = 900000000000013009)
    AND (`d`.conceptId=[some-concept-id] AND (`rs`.`refsetId` = `configLangId`()))

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7.5.2.3 Access to Relationships

A terminology server should enable a client application to rapidly find the current version of any Relationship or set of Relationships by any of the following criteria:

- Its unique Identifier Relationship.id;
- sourceId
- sourceId, characteristicTypeId and typeId
- sourceId, characteristicTypeId, relationshipGroup and typeId
- destinationId
- destinationId, characteristicTypeId and typeId

Once a Relationship has been found the client application should be able to read the values of any of the properties of that Relationship:

- Provided directly as Relationship file fields:
  - active;
  - sourceId
  - characteristicTypeId
  - typeId
  - destinationId
  - relationshipGroup
  - modifierId

- Provided indirectly in the concepts that it refers to:
  - For example Using and traversing relationships.

7.5.2.3.1 Using and traversing Relationships

The defining Relationships of a concept can be shown by following the relevant concept identifier and displaying the relevant terms as shown in Figure 109.

```
/* sv_relationship is a snapshot view of the relationship file */
/* sv_pref is a snapshot of descriptions filtered to preferred term */
SELECT  `r`.`typeId` AS `type_id`, `typ`.`term` AS `type_term`
,`r`.`destinationId` AS `dest_id`, `dest`.`term` AS `dest_term`
,`r`.`relationshipGroup` AS `relationshipGroup`
FROM (((`sv_relationship` `r`
JOIN `sv_pref` `src`
ON ((`r`.`sourceId` = `src`.`conceptId`)))
JOIN `sv_pref` `typ`
ON ((`r`.`typeId` = `typ`.`conceptId`)))
JOIN `sv_pref` `dest`
ON ((`r`.`destinationId` = `dest`.`conceptId`)))
WHERE ((`r`.`active` = 1)
AND (`r`.`characteristicTypeId` = 900000000000006009)
AND (`r`.`sourceId` = [some-concept-id]));
```

Figure 109: Showing the defining Relationships of a concept

A simplification of the defining Relationship query can be used to return the supertype parent concepts as shown in Figure 110.

```
/* sv_relationship is a snapshot view of the relationship file */
/* sv_pref is a snapshot of descriptions filtered to preferred term */
SELECT `r`.
```

JOIN `sv_pref` `d`
ON ((`r`.`destinationId` = `d`.`conceptId`)))
WHERE ((`r`.`active` = 1)
AND (`r`.`typeId` = 116680003)
AND (`r`.`sourceId` = [some-concept-id]));

Figure 110: Showing the supertype parents of a concept

By swapping the `sourceId` and `destinationId` from the previous example the subtype children of the concept can be displayed as shown in Figure 111.

/* sv_relationship is a snapshot view of the relationship file */
/* sv_pref is a snapshot of descriptions filtered to preferred term */

SELECT `r`.`sourceId` AS `id`,`d`.`term` AS `term`,`r`.`destinationId` AS `conceptId`
FROM (`sv_relationship` `r`
JOIN `sv_pref` `d`
ON ((`r`.`sourceId` = `d`.`conceptId`)))
WHERE ((`r`.`active` = 1)
AND (`r`.`typeId` = 116680003)
AND (`r`.`destinationId` = [some-concept-id]));

Figure 111: Showing the subtype children of a concept

7.5.3 Access to essential concept Identifiers

Terminology servers should provide efficient access to the Identifiers that represent concepts with structurally significant Roles within the terminology. Table 219 lists the concepts that have the most clear-cut structurally significant Roles. A terminology server should enable access to these Identifiers by an easy to use name of enumeration. In addition a terminology server should provide a service that rapidly determines whether a given concept is a subtype of any of these concepts. It is also useful to for the terminology server to extend similar functionality to all direct subtypes of the root concept ( | SNOMED CT Concept |) and to subtype descendants of | concept model attribute |.

Table 219: Essential concept Identifiers

<table>
<thead>
<tr>
<th>Id</th>
<th>Preferred Term</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>138875005</td>
<td></td>
<td>SNOMED CT Concept</td>
</tr>
<tr>
<td>9000000000000441003</td>
<td></td>
<td>SNOMED CT Model Component</td>
</tr>
<tr>
<td>9000000000000442005</td>
<td></td>
<td>core metadata concept</td>
</tr>
<tr>
<td>9000000000000454005</td>
<td></td>
<td>foundation metadata concept</td>
</tr>
<tr>
<td>9000000000000455006</td>
<td></td>
<td>reference set</td>
</tr>
<tr>
<td>116680003</td>
<td></td>
<td>is a</td>
</tr>
<tr>
<td>Id</td>
<td>Preferred Term</td>
<td>Significance</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>246061005</td>
<td>attribute</td>
<td>All Attribute (relationship type) concepts are subtypes of this concept.</td>
</tr>
<tr>
<td>410662002</td>
<td>concept model attribute</td>
<td>With the exception of the subtype Relationship (see above) all relationship types that are used in the SNOMED CT Concept Model are subtypes of this concept.</td>
</tr>
<tr>
<td>370136006</td>
<td>namespace concept</td>
<td>Each subtype of this concept represents an extension namespaces allocated by the IHTSDO.</td>
</tr>
<tr>
<td>363743006</td>
<td>navigational concept</td>
<td>Subtypes of this concept to provide nodes in navigation hierarchies. They act as grouper categories that do not have any semantic meaning and thus do not appear elsewhere in the SNOMED CT hierarchy.</td>
</tr>
</tbody>
</table>

### 7.6 User Interface Terminology services

This section of the guide is concerned with Terminology services that allow users to view and select of SNOMED CT Concepts and Descriptions.

#### 7.6.1 Text Searches

Effective implementation of SNOMED CT depends on the speed and simplicity with which users can locate the terms and concepts that they wish to use. A busy clinical user may become frustrated if the content they need cannot be quickly located when they search using familiar words or phrases. For this reason an efficient search strategy should address the following issues:

- **Speed of search:**
  - Search speed should be optimised by use of appropriate indexes.

- **Search should not be too sensitive to word order or exact phrasing:**
  - Search should be insensitive to word - order variants:
    - For example, "head pain" for | pain in head |
  - Allow use of acronyms or abbreviations for frequently used terms:
    - For example, "MI" for "myocardial infarction" or "mitral incompetence".
  - Search should take account of word form variants:
    - For example, "inflamed", "inflammatory", "inflammation".

- **Excessive search results should not hinder selection of the required concept:**
  - When several synonyms of the same concept match the search key, only one should be displayed.
The purpose of this section of the implementation guide is to describe strategies a developer might use to implement the search requirements outlined above.

The SNOMED CT Developer Toolkit contains several files, which help to support efficient search mechanisms. These include the Excluded Words Table, four keyword indexes and the Word Equivalents Table summarised by Table 32.

7.6.1.1 Single keyword index

The single keyword table, (DescWordKey), provides a pointer from each keyword used in any Description, to the Descriptions in which that keyword is used. The purpose of the single keyword index is to support a search capability, which is independent of the order in which words appear in a description. The single keyword index represents the minimum necessary supporting structure for searches on SNOMED CT content. Searches involving target words that appear in many descriptions may be unacceptably slow if searches are carried out using the single keyword index alone. Developers wishing to produce applications with faster search times are encouraged to supplement their system with a multiple keyword index such the DescDualkey table (see Word Search Tables) provided as part of the SNOMED CT release.

Note that some words that are used in description are linking words, which are unlikely to be in the target of a search. These words are not considered to be keywords and may be excluded from the keyword index. They are found in Excluded Words File.

7.6.1.1.1 Generating the single keyword index

Although single keyword indexes are available as part of the International Release, developers need to know how to add keyword entries for any locally generated descriptions added as part of an Extension.

Entries may be added to the single keyword table by following the method outlined below.
For each description, parse the text of the term:

- To avoid inappropriate case mismatches, convert all characters to the same case.
- Extract words by breaking at spaces, punctuation marks, and brackets.
- For each word:
  - If the word is not in a list of excluded words, add a row to keyword tables;

7.6.1.1.1 Example: Generation of keywords for a sample Description

<table>
<thead>
<tr>
<th>Table 220: Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description Identifier</strong></td>
</tr>
<tr>
<td>22565018</td>
</tr>
</tbody>
</table>

- Convert all characters to the same case.
  - Convert all characters to the same case.
  - Extract words by breaking at spaces, punctuation marks, and brackets.
  - For each word:
    - If the word is not in a list of excluded words, add a row to keyword tables;
Table 221: DescKey Words

<table>
<thead>
<tr>
<th>KeyWord</th>
<th>Description Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>PYROGALL</td>
<td>22565018</td>
</tr>
<tr>
<td>OXYGENAS</td>
<td>22565018</td>
</tr>
</tbody>
</table>

Table 222: ConcKeyWords

<table>
<thead>
<tr>
<th>KeyWord</th>
<th>Concept Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>PYROGALL</td>
<td>13185000</td>
</tr>
<tr>
<td>OXYGENAS</td>
<td>13185000</td>
</tr>
</tbody>
</table>

7.6.1.1.2 Search using the single keyword index

A single keyword search may be conducted as follows:

- The user-typed search string is converted to consistent case;
- The string is parsed, breaking at spaces and punctuation characters;
- One word is selected from the parsed word list to use as a look-up on the single keyword index;
- Look-up on the single keyword index may be "exact" or "starts with," depending on wild card conventions used in the search string.

7.6.1.1.2.1 Example: Search using single key-word index

The user searches for "Hip* replacement*" (where "*" represents the wild card for any number of extra characters).

- The user-typed search string is converted to consistent case.

"Hip* replacement" -> "HIP* REPLACEMENT*"

- The string is parsed, breaking at spaces and punctuation characters.

"HIP* REPLACEMENT*" -> (1) "HIP*"
(2) "REPLACEMENT*"

- Look up "HIP*" on the single keyword index using "starts with" query.

Table 223: Example results for a Search for "hip"

<table>
<thead>
<tr>
<th>Count</th>
<th>Description Identifier</th>
<th>Concept Identifier</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49926016</td>
<td>29836001</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>196344018</td>
<td>24136001</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2296013</td>
<td>736004</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1480791012</td>
<td>386649003</td>
<td></td>
</tr>
</tbody>
</table>
Descriptions in the search results are converted to consistent case and screened, to see if they contain any words starting with "REPLACEMENT" - only those terms that do are included in the final search results.

Using a Dual Key index is more efficient as the same search finds only 11 matches.

Table 224: Sample results of a search for "hip replacement" using DualKey "HIPREP"

<table>
<thead>
<tr>
<th>Count</th>
<th>Description Identifier</th>
<th>Concept Identifier</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>315</td>
<td>371616001</td>
<td>1210239015</td>
<td>methenamine hippurate 1g tablet</td>
</tr>
</tbody>
</table>

7.6.1.2 Multiple keywords

The performance of single keyword searches is highly dependent on the number of candidate descriptions returned by the keyword for subsequent filtering. The extremely high number of matches for some words in common use makes it likely that some searches will be unacceptably slow.

One way to alleviate this problem would be to create a table containing a row for all combinations of word pairs in each description. In some database environments that support optimisation of multiple key searches, this may offer no benefits. However, in other environments, such a table may substantially speed searches.

A comprehensive word pair table would be very large. Such a table covering the full content of SNOMED CT would contain approximately 1.5 million unique word pairs and 6 million rows. Limiting the unique keys to the first three letter of each word reduces the table size to a more readily optimised set of keys. This requires the final part of the search to be conducted using text comparison (since the keys are incomplete).

7.6.1.2.1 Generating the DualKey index

Although Dualkey indexes are available as part of the Developer Toolkit, it is important to know how this table is generated. SNOMED CT users that generate Extensions should follow the method outlined below to generate new entries in the Dualkey index, based on the descriptions in the Extension.

For each description, parse the text of the term:

- To avoid inappropriate case mismatches, convert all characters to the same case;
- Extract words by breaking at spaces, punctuation marks, and brackets;
• For each word of three characters or more that is not in the list of excluded words, extract the first 3 characters, and arrange the word fragments in alphabetical order;
• Generate the dual keys for this description by concatenating each word fragment with those that come after it in the list;
• For each dual key, add a row to the word pair tables.

7.6.1.2.1.1 Example: Generation of keywords for a sample Description

Table 225: Sample Description

<table>
<thead>
<tr>
<th>Description Identifier</th>
<th>Concept Identifier</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>33592011</td>
<td>19954002</td>
<td>Total replacement of hip with use of methyl methacrylate</td>
</tr>
</tbody>
</table>

• To avoid inappropriate case mismatches, convert all characters to the same case.

“TOTAL REPLACEMENT OF HIP WITH USE OF METHYL METHACRYLATE”

• Extract words by breaking at spaces, punctuation marks, and brackets.
  1. TOTAL;
  2. REPLACEMENT;
  3. OF;
  4. HIP;
  5. WITH;
  6. USE;
  7. OF;
  8. METHYLE;
  9. METHACRYLATE.

• For each word of three characters or more, that is not in the list of excluded words, extract the first 3 characters, and arrange the word fragments in alphabetical order.

  1. HIP;
  2. MET;
  3. REP;
  4. TOT;
  5. USE.

  Note:
  "OF" is less than 3 characters and is an excluded word, "WITH" is an excluded word and "MET" is duplicated, so we only include it once.

• Generate the dual keys for this description by concatenating each word fragment with those that come after it in the list;
• For each dual key, add rows to the word pair tables.

Table 226: DescDualKey

<table>
<thead>
<tr>
<th>Dual key</th>
<th>Description Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIPMET</td>
<td>33592011</td>
</tr>
<tr>
<td>HIPREP</td>
<td>33592011</td>
</tr>
<tr>
<td>HIPTOT</td>
<td>33592011</td>
</tr>
</tbody>
</table>
### Table 227: ConcDualKey

<table>
<thead>
<tr>
<th>Dual key</th>
<th>Description Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIPUSE</td>
<td>33592011</td>
</tr>
<tr>
<td>METREP</td>
<td>33592011</td>
</tr>
<tr>
<td>METTOT</td>
<td>33592011</td>
</tr>
<tr>
<td>METUSE</td>
<td>33592011</td>
</tr>
<tr>
<td>REPTOT</td>
<td>33592011</td>
</tr>
<tr>
<td>REPUSE</td>
<td>33592011</td>
</tr>
<tr>
<td>TOTUSE</td>
<td>33592011</td>
</tr>
</tbody>
</table>

#### 7.6.1.2.2 Searching for Descriptions using the DualKey index

A search on the dual key index can only be carried out if the user enters a search string that contains at least two word fragments both of which are three characters or more in length. If the search string does not meet this criterion, the single keyword search mechanism must be used.

- The user-typed search string is converted to consistent case;
- The string is parsed, breaking at spaces and punctuation characters;
- For each word of three characters or more, extract the first 3 characters, and arrange the word fragments in alphabetical order;
- Create a dual key by concatenating the first two 3 letter word fragments;
- Use this dual key to look up exact matches on the word pair index;
• Descriptions found by searching on the word pair index are screened, to see if they contain the complete words in the original search string.

7.6.1.2.2.1 Example: Search using word pair index

User searches for "PYRO* 1 OXYGEN***".

• The string is parsed, breaking at spaces and punctuation characters.
  1. "PYRO***";
  2. 1;
  3. "OXYGEN***".

• For each word of three characters or more, extract the first 3 characters, and arrange the word fragments in alphabetical order.
  1. "OXY";
  2. "PYR".

• Create a dual key by concatenating the first two 3 letter word fragments.
  OXYPYR

• Use this dual key to look up exact matches on the word pair index.

Table 228: Sample results of a search for "PYRO* 1 OXYGEN***"

<table>
<thead>
<tr>
<th>Dual key</th>
<th>Description Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OXYPYR</td>
<td>1969019</td>
<td>2,5-Dihydroxy-pyridine oxygenase</td>
</tr>
<tr>
<td>OXYPYR</td>
<td>22565018</td>
<td>pyrogallol 1,2-oxygenase</td>
</tr>
<tr>
<td>OXYPRY</td>
<td>104951019</td>
<td>2,5-Dihydroxy-pyridine oxygenase</td>
</tr>
</tbody>
</table>

• Descriptions found by searching on the word pair index are screened, to see if they contain the complete words in the original search string:
  • Description 1969019 is eliminated since it does not contain the word "1";
  • Description 104951019 is eliminated, it does not contain the word "1" or any word beginning with the string "pyro".

7.6.1.3 Using word equivalents to enhance searches

In healthcare, there are many words with equivalent meanings. Synonyms provide alternative phrases referring to the concept. However, synonyms are not created automatically for every possible combination of words with an equivalent meaning. The success of simple searches using one or more keywords depends on the text of the available descriptions. Therefore searches will fail or will be incomplete where a different equivalent word is used in the search.

For example: "Kidney stone" and "Renal calculus" are synonymous descriptions in SNOMED CT. A search of SNOMED CT for the target phrase "kidney stone fragmentation" yields the result "Percutaneous nephrostomy with fragmentation of kidney stone," while a search for "Renal stone fragmentation" yields no results.

One way of addressing this problem is to maintain a table of word equivalents. A table of this type is a prerequisite for exhaustive synonym generation. An initial set of word equivalents is included in the SNOMED CT Developer Toolkit. Individual implementers will wish to add additional word equivalents to meet the requirements of their particular medical specialty or user needs. This table is an additional resource to assist searching and parsing of phrases. It need not be a comprehensive dictionary of words.
Many searches can be completed without reference to this table so it need not contain every word or equivalent phrase used in SNOMED CT.

Several factors complicate the initial population and subsequent use of the word equivalents table:

- A phrase of two or more words may be equivalent to a single word.

  Example:
  "Endoscopic oesophagus examination" is equivalent to "esophagoscopy"

- A word may have more than one meaning, and in this, only one meaning of a pair of words may be equivalent. Thus an apparent enhancement of a search may in practise lose some of the specificity of the intended search.

  Example:
  "Tap" and "aspiration" are equivalent in the context of terms such as "pleural tap", "pleural aspiration", but not in the context of a "patella tap", a physical "tap" on a bag or catheter, or the clinical disorder "neonatal aspiration syndrome".

- When searching using incomplete words and/or wildcards, use of word equivalents may impede effective searches by increasing the number of spurious potential matches. This either extends the processing required to filter the real matches from the potential matches or increases the length of the list of choices presented to the user.

A wise system developer will allow the user to customise their search options, enabling searches to be narrowed, or extended to meet the needs of varying circumstances.

7.6.1.3.1 Example: Using word equivalents table to extend a failed search

A system user enters the search string "Fragmentation of renal calculus;" the search returns no results. The search application that the user has been provided with has the option to extend the search by using the word equivalents table. The user selects this option and searches again using the same search string.

The word equivalents table contains the following relevant entries:

Table 229: Word Equivalents Table Example

<table>
<thead>
<tr>
<th>WordBlockNumber</th>
<th>WordText</th>
<th>WordType</th>
</tr>
</thead>
<tbody>
<tr>
<td>1021</td>
<td>KIDNEY</td>
<td>2 (word equivalent)</td>
</tr>
<tr>
<td>1021</td>
<td>RENAL</td>
<td>2 (word equivalent)</td>
</tr>
<tr>
<td>4430</td>
<td>CALCULUS</td>
<td>2 (word equivalent)</td>
</tr>
<tr>
<td>4430</td>
<td>CALCULI</td>
<td>1 (word form variant)</td>
</tr>
<tr>
<td>4430</td>
<td>STONE</td>
<td>2 (word equivalent)</td>
</tr>
<tr>
<td>9870</td>
<td>RENAL STONE</td>
<td>4 (equivalent phrase)</td>
</tr>
<tr>
<td>9870</td>
<td>KIDNEY STONE</td>
<td>4 (equivalent phrase)</td>
</tr>
<tr>
<td>9870</td>
<td>KIDNEY CALCULUS</td>
<td>4 (equivalent phrase)</td>
</tr>
<tr>
<td>9870</td>
<td>RENAL CALCULUS</td>
<td>4 (equivalent phrase)</td>
</tr>
<tr>
<td>9870</td>
<td>NEPHROLITH</td>
<td>2 (word equivalent)</td>
</tr>
</tbody>
</table>
The table is used to make substitutions in the search string to produce all possible unique search variants:

"Fragmentation of renal calculus"
"Fragmentation of renal stone"
"Fragmentation of kidney stone"
"Fragmentation of kidney calculus"
"Fragmentation of Nephrolith"
"Fragmentation of renal calculus"
"Fragmentation of renal calculi"
"Fragmentation of kidney calculi"

These 8 search strings are used as the target phrase for keyword searches on the word pair index. Results from all 8 searches are combined, and duplicate concepts are eliminated, giving the final list of search results.

Rationalising searches that return duplicate hits

In the previous sections of this guide, we have considered methods of ensuring that searches on a target phrase maximise the possibility of finding the concept that the system user requires. It is equally important to prevent the search results from containing excessive matches, since these will require filtering by the user, imposing an additional burden. Some strategies for limiting the number of search results displayed are discussed in the following sub-sections.

7.6.1.4.1 Avoiding multiple hits on the same concept

In many instances several synonyms associated with the same concept contain the same keyword. The designer of search software may consider filtering the output of search results so that only the first matching description for a concept is displayed.

Example:

"Endoscopic examination of the stomach" and "endoscopy of the stomach" are synonyms of the same concept. A search for the target phrase "endo* stomach" would return the first phrase found during the search. The second would be excluded, since it has the same concept identifier as an existing match for this search.

7.6.1.4.2 Constraining and extending search parameters

User configurable options may be one way of limiting search results. Three possible methods of limiting search results through user configurable options are suggested here:

- Limiting searches to exact matches unless wild cards are used. A search on a single word may produce many matches if it is assumed that the user is searching for any phrase that contains the target word. Forcing the use of wild cards for this kind of search can help avoid this problem.
- Make searches that include use of "word equivalents" a user configurable option that can be used to extend or constrain a search.
- Display search results a few at a time, with most frequently used descriptions listed first. This option will require the application to track the frequency of term selection so that search results can be sorted in this way.

7.6.2 Hierarchical Navigation

This section of the guide describes the Terminology services that are likely to be required to navigate SNOMED CT hierarchies.

One of the key strengths of SNOMED CT is a rich set of relationships that connect the concepts within the terminology. The primary use of these relationships is to facilitate selective retrieval. However, some of these relationships are arranged in hierarchies that can be navigated using an appropriate user-interface control. For example, the subtype hierarchy formed by the is a relationship can be used to navigate from a selected concept to another concept that has a more specific or less specific meaning.
SNOMED CT also specifies standard ways to represent multiple navigation hierarchies that can be designed to meet different requirement. Unlike relationship based hierarchies, navigation hierarchies convey no semantic information but are intended to be used to enhance the user experience when navigating through the terminology.

7.6.2.1 Access to hierarchically related concepts

Terminology servers should enable client applications to access collections of Concepts that are related to a specified Concept as:

- Subtype children
- Subtype descendants (includes all generations of children);
- Supertype parents
- Supertype ancestors (includes all previous generations of parents).

7.6.2.2 Using | is a |Relationships for hierarchy navigation

7.6.2.2.1 The SNOMED CT hierarchy

The “SNOMED CT hierarchy” refers to the organisation of concepts in SNOMED CT from the general, at the top of the hierarchy, to the more specific or “granular” at the bottom. The concepts that make up the very top level of the hierarchy are shown in Table 230. All other SNOMED CT concepts fall under one or more of these categories.

Table 230: Top Level Concepts

| Physical force | Event |
| Subtype children |
| Subtype descendants (includes all generations of children); |
| Supertype parents |
| Supertype ancestors (includes all previous generations of parents). |

Several levels of increasingly fine categorisation may exist between the top level of the hierarchy and concepts that have sufficient detail to be recorded in a patient’s medical record. Figure 112 shows the levels of hierarchy that exist between the top-level Concept Clinical finding and the finding “Catatonic reaction.”

![Figure 112: Hierarchy example: Catatonic Reaction](image)

Figure 112: Hierarchy example: Catatonic Reaction

7.6.2.2 Hierarchy Representation in the relationships table

The SNOMED CT Relationship table represents relationships between one SNOMED CT concept and another by including a row in the table for each such relationship. The columns sourceId, typeId and destinationId define the source of the relationship, the kind of relationship that exists and the target of the relationship respectively. Each of these fields, contains a SNOMED CT Concept Identifier.
Hierarchical relationships are expressed by linking the source concept to its "parents" (i.e. the concept or concepts immediately above it in the hierarchy). The typeId used to represent the subtype hierarchy is the | is a | relationship.

For example, we can say | catatonic reaction | | is a | | psychological finding |. This is expressed in the Relationship Table as follows:

**Table 231: Subtype Relationship Example**

<table>
<thead>
<tr>
<th>sourceId</th>
<th>typeId</th>
<th>destinationId</th>
</tr>
</thead>
<tbody>
<tr>
<td>102909009</td>
<td>116680003</td>
<td>116367006</td>
</tr>
</tbody>
</table>

Where:
- 102909009 is the concept identifier for | catatonic reaction |;
- 116680003 is the concept identifier for the | is a | relationship;
- 116367006 is the concept identifier for | psychological finding |.

Conversely, by inverting the | is a | relationship we can find the children of the target Concept, (i.e. the Concept or Concepts immediately below it in the hierarchy).

### 7.6.2.2.3 Using | is a | Relationships to enhance search capabilities

This section is concerned with the ways in which the hierarchy can be used to help a SNOMED CT user when they are searching or browsing the terminology.

**Note:** The primary use of the SNOMED CT subtype hierarchy is to support effective retrieval and aggregation of data. This is discussed in Testing and traversing subtype relationships.

It is possible to start at the top of hierarchy and navigate from parent to child in order to find a Concept or term in SNOMED CT. A more efficient approach, however, is to use the hierarchy to supplement a keyword search by enabling the user to look at related Concepts in order to consider them as alternative matches, or to check the context of a search result. The following examples illustrate these two uses of the SNOMED CT hierarchy.

**Example:**

1. **Checking supertypes:**
   - A user wishes to find a description that relates to the condition of a patient who is hypersensitive to an allergen. The user performs a search on the keyword "Hypersensitivity" and finds an exact match. Before the user selects the description for inclusion in the patient record, they check the Fully Specified Name, which is "Sensitivity (finding)." The user then checks the hierarchy and discovers that the selected Concept has "Psychological finding" as an ancestor, which indicates that this is not the correct description to use in this context.

2. **Checking subtypes:**
   - A user wishes to find a description that relates to the condition of a patient who is hypersensitive to an allergen. The user searches for the keyword "allergy," and finds one Concept having a description that is an exact match. The user then looks at the children of the Concept (i.e. those concepts immediately below it in the hierarchy). One of the children has the preferred description "Contact Hypersensitivity" which matches the user's intended meaning. The user selects this Concept for inclusion in the patient record.

### 7.6.2.2.4 Using | is a | Relationships to display hierarchical information in applications

Most visual application development tools contain a component designed to display hierarchical information as a tree in which branches can be expanded or collapsed. Tree views are well-suited to displaying SNOMED CT hierarchical Relationships (see Figure 113). These views are used in many different user-interfaces where information needs to be represented as a hierarchy (e.g. displaying a file-system as a hierarchy of folders or providing a collapsable outline of a document or help file). Therefore, most users will already be familiar this paradigm.
Figure 113: SNOMED CT hierarchy represented in a tree view

The process of creating a tree view from the SNOMED CT Relationship table is straightforward as long as a few simple ideas are mastered:

- Most standard tree-views controls start from a single root and require that higher level branches must be added before sub-branches. This means that when viewing part of the hierarchy from the bottom up, the tree must be compiled in temporary form before it can be displayed.
- Since the depth of the hierarchy is not known in any particular case, operations that iterate up or down the depth of the hierarchy must be done using a recursive algorithm. However, this recursion must usually be limited since placing the entirety of the SNOMED CT hierarchy in a single tree control is likely to create performance issues and may exceed physical limits on the capacity of the control.
• Standard tree view controls are not good at displaying the multiple parent nodes that occur in a polyhierarchy like SNOMED CT. Therefore, some compromises need to be made to present options for navigation up the hierarchy.

• Effective use of some tree controls requires unique keys for each node. Multiple parents and multiple roots through the hierarchy mean that the same Concepts will appear in multiple places in the hierarchy. Therefore, the concept identifier cannot be used to provide a key that is globally unique within the hierarchy.

7.6.2.3 Using | Part of |Relationships for hierarchy navigation

In addition to the subtype hierarchy represented by | is a | relationship, SNOMED CT also represents a partonomy hierarchy using | Part of | relationship. This creates an alternative hierarchy which can be also be used for navigation. The difference between these hierarchies is that:

• The subtype hierarchy relates concepts to supertypes that represent more general concepts. Each body structure concept has an | is a | relationship to one or more concepts that represents the whole or any part of the organ or other body part that contains it. Concepts that represent the whole or any part of an organ or body part are distinguished by their fully specified names which include the word ‘structure’. These contrast with concepts that represent the entirety of an organ or body part which contain the word ‘entire’.

  Example: | Right ventricular structure | | is a | | heart structure |

• The partonomy hierarchy relates body structure to concepts to concept that represent | the entirety of | or an organ or anatomical structure of which they form part

  Example: | Entire right ventricle | (is) | part of | | entire heart |

Note: In everyday speech the word "heart" may mean either | heart structure | or | entire heart | and the distinction between them is often overlooked. However, from a semantic perspective the difference is highly significant. The removal of some part of an organ does not imply the removal of the entire organ. Thus, while it is correct to state that | Right ventricular structure | | is a | | heart structure |, it would be wrong to state that | Entire right ventricle | | is a | | entire heart | or | Right ventricular structure | | is a | | entire heart |.

7.6.2.4 Using other Relationships to navigate SNOMED CT content

Many SNOMED CT Concepts have relationships with content in other areas of terminology. These Relationships are one of the ways in which SNOMED CT provides computer readable definitions for medical concepts. For example, diseases in SNOMED CT generally have a Relationship to the body site affected by the disorder and a Relationship to the morphology associated with the disease. Procedures in SNOMED CT might have Relationships to the concept, which defines the type of surgical action being carried and the procedure site, for example. Examples of Relationships for a disease and a procedure are shown below. A full list of the Relationships that can be used for each type of Concept can be found in Table 103.
These Relationships are very useful in the context of data retrieval and analysis. The Relationships can also be used to aid in the search for specific SNOMED CT Concepts in cases where the term alone may not sufficiently distinguish between choices. For example, a search for all inflammatory diseases of the lung could be carried out as follows:

- Use the hierarchy to compile a list of all Concepts that are lung structures;
- Search for any Concept that has a row in the relationship file with a Relationship Type of "Disorder site," and with ConceptId2 included in the list of lung structures;
- Now exclude any procedures from the list that do have the | Associated morphology | "Inflammation" in the Relationship table;
- Final product | is a | list of all lung disorders that involve inflammation.

To achieve these same results with a string search we would have to perform separate searches for | pneumonia |, bronchitis, | pleurisy | and many other conditions that cannot be linked via a sample string search.

### 7.6.2.5 Implementing Navigation Hierarchies

This section demonstrates how an Ordered Reference Set is used to specify and display a customised navigation hierarchy. A navigation hierarchy is a hierarchical view of SNOMED CT concepts which may differ from the strict subtype hierarchy (represented by | is a | relationships).

---

**Figure 114: Relationship for disease appendicitis**

**Figure 115: Relationships for procedure craniotomy**
7.6.2.5.1 Navigation Hierarchy Example

To illustrate the way a navigation hierarchy is represent this section uses an example containing a set of concepts used to describe x-ray examinations of the upper and lower limbs. The resulting navigation hierarchy might usefully be extended to include other x-ray procedures but has been kept small for the purposes of the example.

Reference sets are created as explained in how to create a new Reference Set using an existing pattern and their Identifier, name and type are specified by a concept. The example reference set would be specified by a concept with the characteristics shown in Table 232.

Table 232: Concept specifying the Example Navigation Reference Set

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>&lt;RefsetId-A&gt;</td>
<td>These symbolic values are used to avoid any potential confusion with released reference sets. The moduleId represents the module in which the reference set was developed.</td>
</tr>
<tr>
<td>moduleId</td>
<td>&lt;ModuleId-A&gt;</td>
<td></td>
</tr>
<tr>
<td>preferredTerm</td>
<td>Example Navigation Reference Set</td>
<td></td>
</tr>
<tr>
<td>is a</td>
<td>Ordered type reference set</td>
<td></td>
</tr>
</tbody>
</table>

The concepts included in the reference set are shown with their preferred terms in Table 233.

Table 233: Concepts used in the Example Navigation Reference Set

<table>
<thead>
<tr>
<th>Id</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>1225002</td>
<td>radiography of humerus</td>
</tr>
<tr>
<td>1597004</td>
<td>skeletal X-ray of ankle and foot</td>
</tr>
<tr>
<td>168594001</td>
<td>clavicle X-ray</td>
</tr>
<tr>
<td>168619004</td>
<td>plain X-ray head of humerus</td>
</tr>
<tr>
<td>168620005</td>
<td>plain X-ray shaft of humerus</td>
</tr>
<tr>
<td>168623007</td>
<td>X-ray shaft of radius/ulna</td>
</tr>
<tr>
<td>168637003</td>
<td>plain X-ray radius</td>
</tr>
<tr>
<td>168655007</td>
<td>instability views carpus</td>
</tr>
<tr>
<td>168663008</td>
<td>plain X-ray head of femur</td>
</tr>
<tr>
<td>168664002</td>
<td>femoral neck X-ray</td>
</tr>
<tr>
<td>168665001</td>
<td>plain X-ray shaft of femur</td>
</tr>
<tr>
<td>Id</td>
<td>Preferred Term</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td>168669007</td>
<td>patella X-ray</td>
</tr>
<tr>
<td>205115004</td>
<td>radiologic examination of femur, anteroposterior and lateral views</td>
</tr>
<tr>
<td>241063007</td>
<td>bicipital groove X-ray</td>
</tr>
<tr>
<td>241066004</td>
<td>ulna groove X-ray</td>
</tr>
<tr>
<td>241069006</td>
<td>ulna X-ray</td>
</tr>
<tr>
<td>241071006</td>
<td>scaphoid X-ray</td>
</tr>
<tr>
<td>241073009</td>
<td>metacarpal X-ray</td>
</tr>
<tr>
<td>241075002</td>
<td>femur X-ray</td>
</tr>
<tr>
<td>241076001</td>
<td>tibia and/or fibula X-ray</td>
</tr>
<tr>
<td>241077005</td>
<td>tibia X-ray</td>
</tr>
<tr>
<td>241078000</td>
<td>fibula X-ray</td>
</tr>
<tr>
<td>241079008</td>
<td>metatarsal X-ray</td>
</tr>
<tr>
<td>241080006</td>
<td>tarsus X-ray</td>
</tr>
<tr>
<td>268427003</td>
<td>X-ray shaft of tibia/fibula</td>
</tr>
<tr>
<td>271311001</td>
<td>carpal bones X-ray</td>
</tr>
<tr>
<td>302402006</td>
<td>radius and/or ulna X-ray</td>
</tr>
<tr>
<td>37815002</td>
<td>diagnostic radiography of calcaneus</td>
</tr>
<tr>
<td>40348008</td>
<td>skeletal X-ray of pelvis and hip</td>
</tr>
<tr>
<td>418687005</td>
<td>fluoroscopy of humerus</td>
</tr>
<tr>
<td>427961005</td>
<td>x-ray of acetabulum</td>
</tr>
<tr>
<td>432552002</td>
<td>computed tomography of clavicle</td>
</tr>
<tr>
<td>48966008</td>
<td>skeletal X-ray of shoulder and upper limb</td>
</tr>
<tr>
<td>5433008</td>
<td>skeletal X-ray of lower limb</td>
</tr>
<tr>
<td>70780000</td>
<td>skeletal X-ray of elbow and forearm</td>
</tr>
</tbody>
</table>
The members of the example reference set would be distributed in a file with a name like:

The content of this file is shown in Table 234 and the resulting hierarchical display is shown in Figure 116.

Table 234: Example Navigation Reference Set File

<table>
<thead>
<tr>
<th>Id</th>
<th>Preferred Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>72872009</td>
<td></td>
</tr>
<tr>
<td>79082005</td>
<td></td>
</tr>
<tr>
<td>82420003</td>
<td></td>
</tr>
</tbody>
</table>

- The members of the example reference set would be distributed in a file with a name like:

- The content of this file is shown in Table 234 and the resulting hierarchical display is shown in Figure 116.

Table 234: Example Navigation Reference Set File

<table>
<thead>
<tr>
<th>id</th>
<th>effectiveTime</th>
<th>active</th>
<th>moduleId</th>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>order</th>
<th>linkedId</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;uuid-0211&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>1</td>
<td>5433008</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0212&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>5433008</td>
<td>1</td>
<td>241080006</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0213&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>241080006</td>
<td>1</td>
<td>37815002</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0214&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>5433008</td>
<td>2</td>
<td>241079008</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0215&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>5433008</td>
<td>3</td>
<td>241076001</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0216&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>241076001</td>
<td>1</td>
<td>241078000</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0217&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>241078000</td>
<td>1</td>
<td>268427003</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0218&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>241078000</td>
<td>2</td>
<td>79082005</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0219&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>241078000</td>
<td>3</td>
<td>241077005</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0220&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>5433008</td>
<td>4</td>
<td>241075002</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0221&gt;</td>
<td>20100731</td>
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<td>168665001</td>
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<td>active</td>
<td>moduleid</td>
<td>refsetId</td>
<td>referencedComponentid</td>
<td>adar</td>
<td>linkedId</td>
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<td>&lt;RefsetId-A&gt;</td>
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<td>&lt;RefsetId-A&gt;</td>
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<td>3</td>
<td>1225002</td>
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<td>20100731</td>
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<td>1</td>
<td>241063007</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0241&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
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<td>2</td>
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<td>3</td>
<td>168619004</td>
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<td>&lt;RefsetId-A&gt;</td>
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<td>4</td>
<td>168655007</td>
<td></td>
</tr>
<tr>
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<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>72872009</td>
<td>5</td>
<td>271311001</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0246&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>271311001</td>
<td>1</td>
<td>241071006</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0247&gt;</td>
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<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
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<td>6</td>
<td>241073009</td>
<td></td>
</tr>
<tr>
<td>&lt;uuid-0248&gt;</td>
<td>20100731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>72872009</td>
<td>7</td>
<td>48966008</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Each of the symbolic names `<uuid-0211>` to `<uuid-0248>` in Table 234 represents a unique 128-bit UUID generated by a standard algorithm. Use of the same symbolic names elsewhere in this example indicates a revised version of the same component with the same Identifier. Use of the same symbolic name in another example does not imply the same Identifier.
Figure 116: Example Navigation Reference Set - Hierarchy View

This reference set could be updated by addition of the rows in a subsequent release. If the three rows shown in Table 235 are added in the next version, the results are as follows:
• 48966008 | skeletal X-ray of shoulder and upper limb | is removed from the reference set because the row with id=<uuid-0248> and the most recent effectiveTime is now inactive (active=0);

• The order of 241073009 | metacarpal X-ray | and 271311001 | carpal bones X-ray | are reversed as the most recent row for id=<uuid-0245> has order=6 while the most recent row for id=<uuid-0247> has order=5.

The changed part of the hierarchy is shown in Figure 117.

### Table 235: Example Navigation Reference Set File - Updated Rows

<table>
<thead>
<tr>
<th>id</th>
<th>effectiveTime</th>
<th>active</th>
<th>moduleId</th>
<th>refsetId</th>
<th>referencedComponentId</th>
<th>order</th>
<th>linkedId</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;uuid-0245&gt;</td>
<td>20110731</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>72872009</td>
<td>6</td>
<td>271311001</td>
</tr>
<tr>
<td>&lt;uuid-0247&gt;</td>
<td>20110131</td>
<td>1</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>72872009</td>
<td>5</td>
<td>241073009</td>
</tr>
<tr>
<td>&lt;uuid-0248&gt;</td>
<td>20110131</td>
<td>0</td>
<td>&lt;ModuleId-A&gt;</td>
<td>&lt;RefsetId-A&gt;</td>
<td>72872009</td>
<td>7</td>
<td>48966008</td>
</tr>
</tbody>
</table>

• 5433008 | skeletal X-ray of lower limb |
  • ... unchanged ...

• 72872009 | skeletal X-ray of upper limb |
  • ... unchanged ...

• 168655007 | instability views carpus |
• 241073009 | metacarpal X-ray |
• 271311001 | carpal bones X-ray |
• 241071006 | scaphoid X-ray |

Figure 117: Example Navigation Reference Set - Updated Hierarchy View

#### 7.6.2.5.2 Navigation Hierarchy Inheritance

A Navigation Reference Set may organise some concepts while allowing the subtype hierarchy (or another navigation hierarchy) to provide additional hierarchical links. In this case, a concept that has no children in the navigation hierarchy inherits the children specified in the subtype hierarchy or a specified default navigation hierarchy.

#### 7.6.2.6 Using Tree View Components for Hierarchy Display

The two examples given below show the creation of a tree view from a small sample hierarchy. The principals used can be extended to any size or depth of hierarchy.

**7.6.2.6.1 Example 1: Show all descendants of Concept "A" in a tree view**

### Table 236: Example Relationships

<table>
<thead>
<tr>
<th>sourcelId</th>
<th>typelId</th>
<th>destinationId</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>is a</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>is a</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>is a</td>
<td>B</td>
</tr>
<tr>
<td>E</td>
<td>is a</td>
<td>B</td>
</tr>
<tr>
<td>sourceId</td>
<td>typeId</td>
<td>destinationId</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>---------------</td>
</tr>
<tr>
<td>E</td>
<td>is a</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>is a</td>
<td>F</td>
</tr>
</tbody>
</table>

We must process each concept in the hierarchy, starting at ‘A’. Add a tree node for ‘A’, and then query to get the children of ‘A’. Process each child recursively, i.e. add a node to the tree view for the child, then query for its children, etc.

Table 237: Child nodes

<table>
<thead>
<tr>
<th>Node</th>
<th>Child Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 238: Concept to node cross reference

<table>
<thead>
<tr>
<th>Node</th>
<th>Concept Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
</tr>
<tr>
<td>4</td>
<td>E</td>
</tr>
<tr>
<td>5</td>
<td>C</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
</tr>
</tbody>
</table>

Now we have tree nodes and their children for each Concept. If the nodes have been added to a Windows tree view component, display will be automatic. If a text-based display is being used then the nodes can be output to the screen using the indent style display. Note that the Concept ‘E’ appears in the tree view twice, under each of its parents.
7.6.2.6.2 Example 2 - Show all ancestors of Concept "E"

In order to construct the tree view, we must start from the top down, so we must create a temporary view of the hierarchy before we can add nodes to the tree view. Query to get the parents of ‘E’. Process each parent recursively, i.e. add an entry to the temporary table, stating that ‘E’ is a child of each of its parents, then query to get its parent, etc. When the top of the tree is reached, a record is kept of the top-level concept, since this will be the starting point for building the tree view.

Table 239: Temporary view of the hierarchy

<table>
<thead>
<tr>
<th>Concept</th>
<th>Child Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>E</td>
</tr>
<tr>
<td>C</td>
<td>E</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>C</td>
</tr>
</tbody>
</table>

We can now use the temporary table information to build the tree view from the top down. Starting at A, add a node to the tree view. Work recursively from the information in the temporary view of the hierarchy to add the descendants of ‘A’ into the tree view.
7.6.3 Applying Reference Sets

Refsets can be used for many different purposes. This section outlines some of the ways in which the Refset mechanism specified in this guide can be used to meet different practical requirements. The uses outlined are illustrative examples and do not represent all possible applications of Refsets.

7.6.3.1 Languages and Dialects

The Language Reference Set applicable to the local language, dialect and term preferences should be used to filter or prioritise the display of matching terms.

A SNOMED CT enabled application should be able to:

• Allow a selection of a particular language as a configuration option;
• Restrict access to descriptions so that are acceptable or preferred in the selected language;
• Treat the synonym marked as preferred in the selected language as the default preferred term;
• Treat the Fully Specified Name marked as preferred in the selected language as the Fully Specified Name to be displayed where relevant.

An application may support multiple languages or dialects allowing selection of combinations of Language Reference Sets. In this case, the primary selected language is supplemented by acceptable Descriptions in supplementary languages or dialects.

7.6.3.2 National requirements for specific Concepts

SNOMED CT is designed for use in many different countries and consequently includes a certain number of country-specific Concepts. Each country, may have specific requirements for the
representation of Concepts that are not meaningful in other countries. These variations are particularly significant for the interfaces between clinical care, service administration and reimbursement. National laws and conventions may also create additional refinements of more general Concepts.

Reference Sets included in a National Extension release can be used to configure searches performed by terminology services to meet National requirements.

- Simple Reference Sets can be used to filter search contents;
- Ordered Reference Sets can be used to prioritise search result or provide a natural ordering of search results;
- Attribute Value Reference Sets can be used to filter information based on particular criteria represented by the valueld of particular members of the Reference Set;
- Annotation Reference Sets can be used to supplement the search results with information annotated to a component providing advice on intended use.

A SNOMED CT enabled application should be able to apply National Reference Sets to filter searches.

7.6.3.3 Regional variations in disease prevalence

There are substantial differences in the prevalence of diseases in different regions in which SNOMED CT may be used. Users will expect to find the conditions they commonly deal with, without being distracted by long lists of conditions they rarely see.

A SNOMED CT enabled application should be able to select Reference Sets that represent prevalence characteristics for a particular region. Based on the selected configuration searches should:

- Selectively include or exclude concepts or descriptions based on presence in or absence from a selected Simple Reference Set;
- Prioritise access to concepts or descriptions based on the order specified in a selected Ordered Reference Set.

The way in which access is prioritised depends on the nature of the application and its operating environment. However, examples of prioritisation include:

- Showing descriptions associated with high priority concepts before those with lower priority when searching for word or phrases;
- Showing concepts with high priority before their less highly prioritised siblings in hierarchical displays;
- Initially listing concepts and associated descriptions with priority above a specified threshold and requiring an additional step to access those assigned lower priority.

7.6.3.4 Specialty and discipline-dependent variations in use of Concepts

SNOMED CT contains Concepts used by many different groups of health professionals. The frequency of use of these Concepts depends on the professional discipline and/or clinical specialty of the user. It is important to ensure that the user is able to access the Concepts that they use frequently, without being distracted by thousands of textually similar Concepts they rarely require.

A SNOMED CT enabled application should be able to select Reference Sets that represent the requirements of a particular speciality. Based on the selected configuration searches should:

- Selectively include or exclude concepts or descriptions based on presence in or absence from a selected Simple Reference Set;
- Prioritise access to concepts or descriptions based on the order specified in a selected Ordered Reference Set.

7.6.3.5 Local needs of organisations or individual users

The previous sections have dealt with requirements of countries, regions and specialties. Organisations and individual users may also have similar requirements for restricting or prioritising access to particular Concepts.

A SNOMED CT enabled application should be able to rationally combine Reference Sets that represent National, Regional, specialty and local requirements. Based on the selected configuration searches should:
• Selectively include or exclude concepts or descriptions based on presence in or absence from selected Simple Reference Sets;
• Prioritise access to concepts or descriptions based on the order specified in the selected Ordered Reference Sets.

7.6.3.6 Supporting data entry protocols

Many clinical applications include facilities for data entry to be controlled or assisted by protocols, templates or structured data entry forms. Different sets of candidate terms or concepts may be appropriate to each data entry field. The sets of candidate terms or concepts for a field may be very large (e.g. any operative procedure) or very small (e.g. the possible observations from a particular examination).

Reference sets can be used to restrict the available options to match the requirements of a particular data entry protocol. Reference Sets provided by the author of the protocol can be applied to particular fields on a screen or particular data entry steps to configure relevant searches.

• Simple Reference Sets can be used to filter search contents;
• Ordered Reference Sets can be used to prioritise search result or provide a natural ordering of search results;
• Attribute Value Reference Sets can be used to filter information based on particular criteria represented by the valueld of particular members of the Reference Set.
• Annotation Reference Sets can be used to supplement the search results with information annotated to a component providing advice on intended use.

A SNOMED CT enabled application should be able to dynamically select a particular configuration based on identification of the data entry step or context. It should then be able to apply the relevant Reference Sets to provide an appropriate set of data entry options and/or to constrain text searches.

7.6.3.7 Managing the coded content of messages

A Simple Reference Set may be used to represent value set applicable to a particular field in a message. The entry of data to populate that field in the message can be constrained by filtering searches so that only concept in that Reference Set are returned.

Healthcare messages include fields that can be populated with codes from clinical coding schemes. SNOMED CT provides concept identifiers as a means of encoding Concepts. These concept identifiers are suitable for use in appropriate fields of many clinical messages.

Implementations of clinical messaging typically constrain the range of values that can be applied to particular fields. There are several reasons for this:

• To ensure that the information encoded is meaningful as a value for the specified field.

Example:
A field that is intended to describe the nature of investigation may contain a code that means “Serum glucose measurement" but should not contain a code that means "Hypoglycemia."

• To ensure that receiving application is able to process the message.

Example:
A locally added code value may be valid in a particular application but should not be used if the receiving application needs to retrieve, process or analyse the coded part of the message.

• To ensure adequate detail and specificity.

Example:
A field used to report an operative procedure could contain a code for "Abdominal procedure." However, this would not be adequate to meet the business purpose served by a message.

• To avoid unnecessary detail or diversity.
Example:
A biochemical investigation could be reported using a code that represents various detailed aspects of the method used to perform the investigation. Such details may be unnecessary to a clinician and may complicate the analysis, charting and graphing of a series of results reported at different levels of detail.

7.6.4 Access to qualifiers and refinable characteristics

A terminology server should enable an application to review the refinable defining characteristics and the specified set of qualifying characteristics for any selected Concept.

7.7 Testing and traversing subtype Relationships

The subtype hierarchy represented by | is a | relationships is an essential element in the structure and semantics of SNOMED CT. All SNOMED CT enabled terminology servers need to provide functions that test and traverse these relationships to navigate the hierarchy and to determine whether a concept is a subtype of another specified concept.

7.7.1 Top-level ancestor checking

Terminology servers should allow client applications to rapidly determine the top-level Concept that is the supertype ancestor for any specified Concept.

Each Concept has only one top-level supertype and this represents the semantic-type of the Concept.

7.7.2 Navigation concept checking

Terminology servers allow client applications to determine whether a specified Concept | is a | navigation Concept.

7.7.3 Subtype descendant testing

Terminology servers should be able to test whether any specified Concept | is a | descendant subtype of another specified Concept.

7.7.4 Subtype search scope restriction

Terminology servers should be able to restrict searches so that they return only those Concepts and (or their associated Descriptions) that are subtype descendants of a specified Concept.

Subtype search scope restriction is particularly valuable with respect to top-level Concepts. For example, when searching for a procedure it is useful to be able to exclude disorders or findings that may contain similar words of phrases.

Generalising subtype search scope restriction to other nodes in the subtype hierarchy may significantly enhance usability in some situations.

Example:
When undertaking an ophthalmologic examination, a search for findings could be constrained to findings related to the eye, increasing the specificity of results of searches for phrases containing the word "fundus."

Optimising concept subsumption testing

Rapid and efficient computation of whether a concept | is a | subtype descendant of another concept is essential for effective transformation of expressions and for testing subsumption between expressions.
7.7.5.1 Approaches to concept subsumption testing

The SNOMED CT Technical Implementation Guide discusses several strategies for delivering efficient computation of subsumption between concepts. These are briefly summarised here with a brief evaluation of their suitability.

7.7.5.1.1 Recursive testing of subtype Relationships

It is possible to determine whether one concept subsumes another concept by recursively following every possible sequences of | is a | Relationships from a candidate concept until the predicate concept is reached or until all possible paths have been exhausted.

This approach is far too slow to deliver effective implementations in all environments in which it has been tested to date.

7.7.5.1.2 Semantic type Identifiers and hierarchy flags

Flags added to the internal representation of each Concept can be used to indicate the set of high-level concept nodes of which that concept is a subtype. A concept can only subsume concepts that include the same set of high-level concept flags. This approach can reduce the number of tests that need to be performed to recursively test the subtype relationships:

• If a candidate does not have all the high-level node flags that the predicate has, no further tests are needed. The candidate is not a subtype of the predicate.
• Even if a candidate shares the high-level node flags with the predicate, any path that reaches a concept that does not share those flags need not be further tested.

While faster than the unaided recursive testing approach, this is too slow to deliver effective implementations and is not scalable.

7.7.5.1.3 Use of proprietary database features

Some databases include additional features to support the recursive testing of a chain of hierarchical relationships. Other methods of optimisation that may be applied to allow more rapid computation of subtype descendant relationships are outlined in the following subsections.

Current experiences of databases that support this type of approach indicate that (while easy to implement) the performance is substantially inferior to use of branch-numbering or transitive closure.

7.7.5.1.4 Branch numbering

The internal representation of each Concept can be extended to include a branch-number and a set of branch-number -ranges.

A branch-numbering algorithm can then be applied when each release of SNOMED CT is imported.

A typical branch-numbering algorithm processes the subtype hierarchy in the following way:

• A depth first tree walk is performed starting from the root Concept (branch-number 1) and an incrementing number is applied to each Concept when it is encountered for the first time.
• After the branch numbers have been computed a further tree walk allocates one or more branch-number ranges to each Concept with any subtype descendants:
  • Many Concepts will have a single branch number range containing all their descendants.
  • Some Concepts will have several non-contiguous ranges of descendant Concept branch numbers:
    • This is because a Concept may have multiple supertypes. Therefore, the descendants of a Concept may have branch numbers that were allocated as a result of their relationship to another ancestor Concept. However, the path from any Concept to the root Concept always converges at or before the top-level Concept. Therefore, multiple ranges coalesce when reaching more general common supertype ancestors.
  • At run time, rather than needing to traverse many subtype Relationships, the branch number of each Concept is tested for inclusion in the branch number range of the putative ancestor.

This approach removes the need for exhaustive testing of subtype Relationships. The disadvantages are a relatively complex build process that must be repeated for each release or update and a requirement for the internal Concept representation to accommodate a variable length representation of branch number ranges.
7.7.5.1.5 Precomputed Transitive Closure table

The *transitive closure* table is a comprehensive view of all the supertypes of every *concept*. It can be derived from current release data by traversing all | is a | *relationships* recursively and adding each inferred supertype *relationship* to a table.

The advantage of this type of view is that a *candidate* - *concept* can be tested for subsumption by *predicate* - *concept* by a simple SQL *query*. In addition, the table can be updated to take account of changes without requiring a complete rebuild. The disadvantage is the storage capacity required.

**Note:** The *transitive closure* table for the active content of the current version of the International *Release*, has about six million rows. The row count increases when *Extensions* are included. Typical database representations of the *transitive closure* table and associated indexes consume more than a Gigabyte of disk storage.

7.7.5.1.6 Recommendations

The *Transitive Closure* method is strongly recommended for use in any environment requiring high performance where disk capacity for storage and/or bandwidth for distribution are not a problem.

Where disk capacity and/or distribution bandwidth are limiting factors, Branch Numbering provides an efficient alternative approach.

7.7.5.2 Transitive closure implementation

**Technology**

The technology used to develop an *SNOMED CT enabled application* or used to query *SNOMED CT* data will affect the selection of the best implementation technique for the *transitive closure*.

If the *transitive closure* will be used to support SQL queries, a full *transitive closure* table needs to be created and stored as a *table in the relational database*.

In the cases where the transitive close will support actions in a software API, testing subsumption between in-memory objects, an *in-memory map* provides the best benefits.

7.7.5.2.1 Transitive closure distribution

It has been proposed that a *transitive closure* table should be released. This would support easier implementation and provide a reference against which to check alternative algorithms. The *transitive closure* table in a *full release* would contain a full history of the *transitive closure* since the first release of *SNOMED CT*. This would allow subsumption queries to be applied based on any release.

At present this table is not distributed and the format for such a distributed *transitive closure* table remains under discussion.

The following sub-sections provide basic advice on generating and using a simple and functional *transitive closure* table. Even if the *SNOMED CT International Edition* *transitive closure* is distributed, implementers may need to generate *transitive closures* including the content from one or more *Extensions*.

7.7.5.2.2 Transitive closure implementation in a relational database

7.7.5.2.2.1 Generating a transitive closure table

There are various ways in which a *transitive closure* table can be generated. The method illustrated here represents the smallest SQL *query* that might be used for this purpose. It may not be the most efficient *query* but on a typical Windows PC generates a snapshot *transitive closure* in about 5 minutes.
Table 240: MySQL script to Create a Snapshot Transitive Closure Table
--- SNOMED CT Transitive Closure for the Active Snapshot --
-- Author: David Markwell 2010-2011 --
-- Complete build of TC table for the most recent RFF2 version --
-- Takes 5 minutes to run on typical system --

--- ASSUMPTIONS
-- 1. Use of MySQL
-- 2. Database called `rf2` exists (or changed Initialize USE command)
-- 3. Database contains a table or view called `soa_relationship`
-- 4. The table `soa_relationship` contains an active snapshot (static or dynamic)
-- of the sct_relationship file(s) (including any extensions)
-- 5. The output table sct2_transitiveclosure contains the snapshot transitive
-- closure after completion.

-- Note: The soa_relationship view created by other sample scripts in this
-- document was used for testing this script.

--- Initialize database connection
USE rf2;

-- Set delimiter to allow procedure creation
DELIMITER $$

-- Create procedure to make the TransitiveClosure
DROP PROCEDURE IF EXISTS `sct2_make_tc`$$
CREATE PROCEDURE `sct2_make_tc`()
BEGIN
-- Initialise by removing existing tables
DROP TABLE IF EXISTS `sct2_transitiveclosure`;
DROP TABLE IF EXISTS `tmp_tc1`;
DROP TABLE IF EXISTS `batch_monitor`;

-- Create a table to allow batch process to be monitored (optional)
CREATE TABLE `batch_monitor` (
  `step` int(11) NOT NULL,
  `time` datetime DEFAULT NULL,
  `recs` int(11) DEFAULT NULL,
  `info` varchar(45) COLLATE latin1_general_cs DEFAULT NULL,
  PRIMARY KEY (`step`)
);

-- Set the snapshot version time
SET @effectiveTime=configTime();

-- Initialize step counter
SET @step=0;

-- Record progress in batch_monitor table
INSERT INTO `batch_monitor` (`step`, `time`, `recs`, `info`) VALUES(@step,NOW(),0,'start');

-- Create empty sct_transitive closure table
CREATE TABLE `sct2_transitiveclosure` (
  `subtypeId` BIGINT(20) NOT NULL ,
  `supertypeId` BIGINT(20) NOT NULL ,
  `effectiveTime` DATETIME,
  `active` BOOLEAN,
  PRIMARY KEY (`subtypeId`,`supertypeId`,`effectiveTime`),
  KEY `ix_tc_main` (`subtypeId`,`supertypeId`),
  KEY `ix_tc_inv` (`supertypeId`);

-- Create temporary first level transitive closure table
CREATE TEMPORARY TABLE `tmp_tc1` (
  `subtypeId` BIGINT(20) NOT NULL ,
  `supertypeId` BIGINT(20) NOT NULL ,
PRIMARY KEY (`subtypeId`,`supertypeId`),
KEY `ix_tc1` (`supertypeId`));

-- Insert Values into First Level TC
INSERT IGNORE INTO `tmp_tc1`(`supertypeId`, `subtypeId`)
SELECT `destinationId`, `sourceId` FROM `soa_relationship`
WHERE `active`=1 AND `typeId`= 116680003;

-- Create Level A temporary table for first iteration
DROP TABLE IF EXISTS `tmp_tcA`;
CREATE TEMPORARY TABLE `tmp_tcA` (
  `subtypeId` BIGINT(20) NOT NULL ,
  `supertypeId` BIGINT(20) NOT NULL ,
PRIMARY KEY (`subtypeId`,`supertypeId`),
KEY `ix_tc2` (`supertypeId`));

-- Copy Level 1 in to Level A for first iteration
INSERT IGNORE INTO `tmp_tcA`(`supertypeId`, `subtypeId`)
SELECT `supertypeId`, `subtypeId` FROM `tmp_tc1`;

-- Start the Loop each pass adds 2 steps to the semantic distance

tcLoop: LOOP
BEGIN
  -- Increment the step count
  SET @step=@step+1;

  -- Count records in Level A
  SET @rcount=(SELECT count(`supertypeId`) FROM `tmp_tcA`);

  -- Batch monitor report (optional)
  INSERT INTO `batch_monitor`
  (`step`, `time`, `recs`, `info`)
  VALUES(@step,NOW(),@rcount,'tcA');

  -- If Level A empty then quit here
  IF @rcount=0 THEN LEAVE tcLoop; END IF;

  -- Append Level A records to final TC table
  INSERT IGNORE INTO `sct2_transitiveclosure`(`supertypeId`, `subtypeId`, `effectiveTime`, `active`)
  SELECT `supertypeId`, `subtypeId`,@effectiveTime,1 FROM `tmp_tcA`;

  -- Create Level B temporary table for this iteration (adds 1 to semantic distance)
  DROP TABLE IF EXISTS `tmp_tcB`;
  CREATE TEMPORARY TABLE `tmp_tcB` (
    `subtypeId` BIGINT(20) NOT NULL ,
    `supertypeId` BIGINT(20) NOT NULL ,
PRIMARY KEY (`subtypeId`,`supertypeId`),
KEY `ix_tc3` (`supertypeId`));

  -- Insert A+1 into B
  INSERT IGNORE INTO `tmp_tcB`(`supertypeId`, `subtypeId`)
  SELECT `t`.
          `supertypeId`, `t1`.
                      `subtypeId`
  FROM `tmp_tcA` `t` INNER JOIN `tmp_tc1` as `t1`
  ON `t`.
          `subtypeId`=`t1`.
                      `supertypeId`
  LEFT OUTER JOIN `sct2_transitiveclosure` `tc`
  ON `t`.
          `supertypeId`=`tc`.
                      `supertypeId` AND `t1`.
                      `subtypeId`=`tc`.
                      `subtypeId`
WHERE `tc`.
          `subtypeId` is null;

  -- Level B empty then quit here
  SET @step=@step+1;

  -- Level A empty then quit here
  SET @rcount=(SELECT count(`supertypeId`) FROM `tmp_tcB`);
INSERT INTO `batch_monitor`  
(`step`, `time`, `recs`, `info`)  
VALUES(@step,NOW(),@rcount,'tcB');  
IF @rcount=0 THEN LEAVE TcLoop; END IF;

-- Append Level B to final TC table  
INSERT IGNORE INTO `sct2_transitiveclosure`(`supertypeId`, `subtypeId`, `effectiveTime`, `active`)  
SELECT `supertypeId`, `subtypeId`,@effectiveTime,1 FROM `tmp_tcB`;

-- Create Level A temporary table for next iteration  
DROP TABLE IF EXISTS `tmp_tcA`;
CREATE TEMPORARY TABLE `tmp_tcA` (  
`subtypeId` BIGINT(20) NOT NULL ,  
`supertypeId` BIGINT(20) NOT NULL ,  
PRIMARY KEY (`supertypeId`),  
KEY `ix_tc3` (`supertypeId`)  
);

-- Insert B+1 into A  
INSERT IGNORE INTO `tmp_tcA`(`supertypeId`, `subtypeId`)  
SELECT `t`.`supertypeId`,`t1`.`subtypeId`  
FROM `tmp_tcB` `t` INNER JOIN `tmp_tc1` AS `t1`  
ON `t`.`subtypeId`=`t1`.`supertypeId`  
LEFT OUTER JOIN `sct2_transitiveclosure` As `tc`  
ON `t`.`supertypeId`=`tc`.`supertypeId` AND `t1`.`subtypeId`=`tc`.`subtypeId`  
WHERE `tc`.`subtypeId` is null;

END;
END LOOP;
END$$

-- END OF PROCEDURE CREATION

-- RUN THE CREATED PROCEDURE
CALL `sct2_make_tc`()$$

-- Delete the procedure  
DROP PROCEDURE IF EXISTS `sct2_make_tc`$$

7.7.5.2.2.2 Transitive closure table structure

The simplest form for a transitive closure table has two columns labelled "SubtypeId" and "SupertypeId". Each of these columns has a datatype that supports the SNOMED CT Identifier and is populated by concept identifiers.

This simple table requires one unique index "SubtypeId+SupertypeId" and a secondary non-unique index by "SupertypeId" to allow efficient reversed lookup.

Additional columns may be included to optimise some extended functionality. For example:

- A flag to indicate rows that represent links between a concept and its proximal primitive supertypes.
- If inactive concepts are included in the table, a flag to indicate the nature of any Historical Association traversed.
- A semantic distance count indicating the number of direct relationship between the subtype and supertype. Although such a number has not absolute meaning it may be useful as a relative measure of proximity.
- An Identifier of the transitive closure row. This may be of value for maintaining history of changes to transitive closures between releases.

7.7.5.2.2.3 Using the transitive closure table to check subsumption

The following SQL queries illustrate ways to use a transitive closure table to test subsumption. The queries here use a MySQL database with the snapshot transitive closure table built as using the script documented in generating a transitive closure table. In practise, the SQL queries shown here will
often be used as clauses in more complex queries allowing many candidates and predicates to be tested as a condition of retrieval in a single query.

```
SET @cptid=233604007;
SELECT `subtypeId`
FROM `sct2_transitiveclosure`
WHERE `supertypeId`=@cptid;
```

**Figure 120:** Return the Concept.id values of all subtype descendants of a specified concept

```
SET @cptid=233604007;
SELECT `supertypeId`
FROM `sct2_transitiveclosure`
WHERE `subtypeId`=@cptid;
```

**Figure 121:** Return the Concept.id values of all supertype ancestors of a specified concept

```
-- This illustration returns a text message indicating the semantic relationships between two concepts
-- Change the concept Id values here to test other concepts.
SET @cptidA=233604007;
SET @cptidB=422588002;
(SELECT CONCAT(CONVERT(@cptidB, CHAR), IF(count(`subtypeId`) '
', ' is ', ' is NOT '), 'a subtype of ', CONVERT(@cptidA, CHAR))
FROM `sct2_transitiveclosure`
WHERE `supertypeId`=@cptidA and `subtypeId`=@cptidB)
UNION
(SELECT CONCAT(CONVERT(@cptidB, CHAR), IF(count(`subtypeId`) '
', ' is ', ' is NOT '), 'a subtype of ', CONVERT(@cptidB, CHAR))
FROM `sct2_transitiveclosure`
WHERE `supertypeId`=@cptidB and `subtypeId`=@cptidA)
UNION
(SELECT CONCAT(CONVERT(@cptidA, CHAR), IF(@cptIdA=@cptidB,' is ',' is NOT ')
', 'a the same as ', CONVERT(@cptidB, CHAR)))
;
```

**Figure 122:** Test whether concept is a subtype of another candidate concept

```
-- This query looks for concepts that:
-- a) are subtypes of a specified concept; and
-- b) contain a term with a string matching a specified pattern.
-- Note: This query requires that the sct2_description table has a FULLTEXT index on `term`.
-- The soa_description view is derived from that table.
SET @cptid=71388002;
SET @pattern='asthma';
SELECT `d`.`conceptId`,`d`.`term` FROM `soa_description` `d`
JOIN `sct2_transitiveclosure` `t` ON `d`.`conceptId`=`t`.`subtypeId`
WHERE MATCH (`d`.`term`) AGAINST (@pattern) AND `t`.`supertypeId`=@cptid;
```

**Figure 123:** Matching terms for subtypes of a specified concept

### 7.7.5.2.3 Transitive closure implementation in memory

For real-time subsumption tests, an in-memory map performs better than a lookup on a persisted table in a relational database.

**Map Structure:**
- Map key: Subtype concept Concept Identifier
- Map value: Collection of direct parents Concept Identifiers

The high speed provided by in-memory structures allow us to have a simpler transitive closure representation, including only the direct parents of the concept (not all the ancestors, like in the relational database approach), and with only one appearance of the subtype concept in the map.
A recursive algorithm will check subsumption for any pair of candidate ids, navigating the map, looking for the parents of the subtype candidate and iteratively for all the parents of the parents, until it reaches the root concept (concept with an empty parents collection on the map value). If the parent candidate is found in any of the parents collections during the recursive map navigation, then iteration stops and the subsumption test returns true.

This approach provides a very compact representation, a full transitive closure map occupies around 12 megabytes.

The map creation process is straightforward, a single iteration of all "Is a" Relationships would retrieve all the necessary information for the map. In an editing environment the update of the map is also very simple, having only the direct parents represented in the map, changes in one concept affect only one value of the map. If the implementation uses a DL Classifier, the whole map should be updated after a classification run.

### 7.8 Supporting Selective Data Retrieval

This section addresses the types of terminology service that are required to enable effective use of the SNOMED CT hierarchies and definitions when retrieving data.

The actual process of data retrieval is a record service, rather than a terminology service because it involves interactions with a database containing instance data (e.g. an electronic health record or data warehouse repository). However, queries may use predicates that specify subtypes of particular concepts or specify concepts that have particular defining Relationships. In order to resolve these queries, the application will need to provide or use Terminology services, adapted to the implementation model in use. The use of either a local extension with a "Managed content addition" strategy, or postcoordinated expressions strategy with an expressions reference table, has an effect on the required set of Terminology services. (see How to choose a SNOMED CT extension strategy)

#### 7.8.1 Creating queries

A terminology server should support the creation of queries that retrieve SNOMED CT encoded data by facilitating the generation of predicate statements.

For example, a terminology server may generate an SQL predicate list that includes the Concept Identifiers of all unique subtype descendants of a specified Concept. Some constraints on this functionality may be necessary as top-level or other general Concepts may generate extremely long lists of descendant Concept Identifiers.

#### 7.8.2 Types of queries

There are different ways of representing a terminology query that can be sent to a terminology server:

- **Concept and Refset references**: lists of ids of concept that can be retrieved from the server.
- **Text based queries**: text phrases that will be applied to concept Descriptions in order to retrieve results for the query.
- **Concept definition queries**: the query provides a concept definition, and the server returns all concepts that are subsumed by, or are equivalent to the definition.
- **Expression retrieval**: predicate terminology expressions that can be applied to all candidate concepts in the terminology to test for inclusion in the results, with filtering by hierarchy and attributes. These expressions are defined using a standard expression grammar that can be parsed and transformed in order to be evaluated against candidate concepts.
- **Query languages**: a query language combines any of the previous data retrieval techniques in the same syntax, including references to concepts by ids, by text searches, by refsets or by hierarchy and attributes.
7.8.2.1 Concept and Refset references

The predicate for search for Concepts or Refsets includes references to one or more specific concepts by Concept Identifier, and additional instructions on how to retrieve related concepts.

Example use cases:

1. An application populates a combo box with a list of concepts pre-defined in a Simple Type Refset, identified by Id.
2. An HL7 message provides a reference to a concept by Id, the preferred term for the local implementation is retrieved based on the conceptId.
3. An application provides a tree view of the hierarchy, the root concept is referenced by Id and any level of children concepts are retrieved based on user selections.
4. A concept and all its descendants are retrieved in order to match with clinical records, where no postcoordination is used.

Example queries:

1. Retrieve the specified Concept Identifier
2. Retrieve direct subtypes (children) of the specified Concept Identifier
3. Retrieve descendants (children and they children recursively) of the specified Concept Identifier.
4. Retrieve members of the Simple Type Refset identified by the specified Concept Identifier

This kind of selective data retrieval can be easily implemented using SQL, Concept Identifiers are the primary key or foreign keys in all the necessary tables in the SNOMED CT model. Retrieval of descendants can be optimised as detailed in the “Optimizing concept subsumption testing” chapter.

Implementations based primarily on precoordinated content will be able to support most of their use cases with this kind of query. SNOMED CT content is distributed with a pre-computed inferred view, that can be trusted to retrieve all related concepts by references to a concept in the terminology.

Implementations that have created local extensions, will require the availability of a Descriptions Logic classifier in order to periodically compute a new inferred view that will discover new relationships between concepts in the terminology.

In use cases where clinical data is recorded as postcoordinated expressions, or where postcoordinated expressions are used as the query, the techniques described in the Expression retrieval section should be applied.

7.8.2.2 Text based queries

Support for Text based queries is a fundamental component of the terminology server.

Example use cases:

1. A user enters a text string that is matched with SNOMED CT content in order to retrieve the most similar candidates
2. A mapping support tool finds closest matches in SNOMED CT for a local terminology or a classification, in order to provide lexical mapping suggestions to users.

This subject is discussed in the User Interface Terminology Services section.

7.8.2.3 Concept definition queries

Concept definition queries allow the user to submit a concept definition to the Terminology Server, and the server returns all the concepts that are either equivalent or subsumed by the input concept definition.

Example use cases: A Hospital gets an concept definition as part of a Decision Support Rule that is shared with another hospital. The hospital staff needs to find out what concepts in their terminology are equivalent or subsumed by that concept definition. They have implemented a Managed Content Additions (MCA) model, and their patient records include references to precoordinated concepts in their local terminology. They don’t store postcoordinated expressions expressions in the clinical record.
Possible representation formats are covered in the *Representational Forms* chapter, and they include *SNOMED CT Release Formats*, *OWL*, *KRSS*, *SNOMED CT postcoordinated expressions* and others.

A *Description logic classifier* is used to classify the *concept* definition with the candidate terminology, being the official distribution of *SNOMED CT* or an extension. The classifier will output the list of equivalent *concepts*, and will create an updated set of inferred *Relationships* that allow the detection of all *descendants* concepts.

However, if the server needs to match a repository of *postcoordinated expressions* the *Expression retrieval* technique becomes the required approach, transforming the *concept* definition into an *expression*.

### 7.8.2.4 Expression retrieval and normal forms

A terminology server should support selective retrieval by facilitating testing of *expressions* against *query predicates*.

Using *expressions* is the most common approach for supporting *postcoordination*.

#### Example use cases:

1. Users define a *postcoordinated expression*, the server verifies if the *expression* is an exact match with an existing *precoordinated concept* or if it will be stored in a *postcoordinated expressions* repository as a new or existing *expression*.

2. For a epidemiological purposes a *predicate expression* is created as a query. The predicate *expression* is matched against candidate *expressions* and *concept* references stored in the clinical record, to retrieve all content equivalent or subsumed by the *predicate expression*.

To facilitate complete and accurate retrieval of *precoordinated* and *postcoordinated expressions* from clinical records or other resources it is necessary to compare an *expression* in a record with a *query predicate*. This comparison needs to determine if the candidate *expression* is subsumed by the *predicate*.

The same meaning can be represented in different *postcoordinated expressions* and to facilitate comparison *expressions* with the same meaning can be converted to a common *normal form*. This section describes the process of normalisation and the approach to testing for subsumption between the resulting *normal form expressions*.

#### 7.8.2.4.1 Candidate and predicate expressions

In a *subsumption test* there are two *expressions*, one of which is being tested for subsumption by the other. To distinguish these expressions the following definitions are used:

**Candidate expression** - An *expression* that is being tested to see if it is subsumed by another *expression*.

**Predicate expression** - An *expression* that is being tested to see if it subsumes another *expression*.

**Table 241: Example Predicate and Candidate Expressions**

<table>
<thead>
<tr>
<th>Predicate</th>
<th>Candidate</th>
<th>Test result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture of femur</td>
<td>Fracture of neck of femur</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Fracture of bone</td>
<td>False</td>
</tr>
<tr>
<td>Fracture of bone</td>
<td>Fracture of femur</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Fracture of neck of femur</td>
<td>True</td>
</tr>
<tr>
<td>asthma (in patient)</td>
<td>FH: Asthma (in patient)</td>
<td>False</td>
</tr>
<tr>
<td></td>
<td>Severe asthma (in patient)</td>
<td>True</td>
</tr>
</tbody>
</table>
7.8.2.4.2 Expression parts

The figures in this section illustrate some terms used to describe different parts of an expression in the discussion of normal forms, the guidance on transforming expressions to normal forms and on testing subsumption and equivalence between expressions.

Figure 124: Focus concepts and refinements

As illustrated by Figure 124, an expression consists of one or more conceptIds plus optional refinements. The refinements may include any number of attributes. Attributes are expressed as name-value pairs and may apply independently or as part of a group.

The name part of the attribute name-value pair is a conceptId that refers to a concept that names the characteristic that is refined by this attribute. The value part of the attribute name-value pair is an expression. In simple cases, this is simply a conceptId referring to a concept that represents the appropriate value for this attribute. However, it may also be a nested expression as shown in Figure 125.

Figure 125 illustrates the potential for nesting of expressions and the naming conventions applied in this guide to distinguish different parts of an expression at different levels. The top level of an expression is referred to as the "focus expression". It consists of a set of one or more "focus concepts" and a "focus refinement". The values of the attributes in the focus refinement are "nested expressions" that consist of one or more "value concepts" optionally refined by a "nested refinement".

Expressions may be nested recursively so there may be further levels of "nested expressions" with "nested refinements". If it is necessary to distinguish the level of nesting, the following naming convention is applied.
### Table 242: Expression Nesting

<table>
<thead>
<tr>
<th>Level number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>level 0 expression</td>
<td>Focus expression</td>
</tr>
<tr>
<td>level 1 expression</td>
<td>Nested expression</td>
</tr>
<tr>
<td>level N expression</td>
<td>An expression nested inside a level ((N - 1)) expression</td>
</tr>
</tbody>
</table>

**Figure 125: Illustration of the names used to refer to parts of a nested expression**

The general pattern shown in Figure 125 applies to all expressions whether or not they include SNOMED CT context information. Figure 126 illustrates the specific features of an expression that includes a representation of SNOMED CT context.

The "focus expression" of a context containing expression is the "context wrapper" and may include a "context refinement" consisting of a set of context attributes:

- | associated finding | or | associated procedure | ;
- | finding context | or | procedure context | ;
- 408732007 | subject relationship context | ;
- | temporal context | .

In a normalised context expression, all context attributes are grouped. Each group in a normalised context wrapper contains a complete set of four context attributes.\(^{25}\)

\(^{25}\) Usually a single group is present in a context expression. Theoretical cases exist for multiple groups where different contexts apply to different aspects of a concept but these cases are beyond the scope of the normalisation rules in this guide.
The value of the associated finding or associated procedure is a "nested expression" which is referred to as the "clinical kernel".

During some stages of processing, the "clinical kernel" is separated from the "context wrapper". When separated from its context the "clinical kernel" is the "focus expression" of a context-free expression.

**Figure 126: Illustration of the names used to refer to parts of an expression that represent context**

### 7.8.2.4.3 Normal forms

A *normal form* is a view that can be generated for any valid expression by applying a set of logical transformation rules. Once converted to their normal forms, expressions can be more easily tested for subsumption by one another.

#### 7.8.2.4.3.1 General characteristics of normal forms

All the conceptIds present in a normal form expression refer to primitive concepts. When normalising an expression, every conceptId is replaced with the normal form expression that represents the definition of the referenced concept.

Normalisation is recursive so that any element of a concept definition that refers to another fully defined concept is also replaced by the normal form of that concept.

One test of normalisation is that applying the rules to an already normalised expression should return an identical expression.

#### 7.8.2.4.3.2 Rationale for long and short normal forms

There are two distinct normal forms that are of value when computing subsumption.

The long normal form is appropriate for a candidate expression because it explicitly states all the attributes can be inferred from concepts referenced by the expression. This makes it easier to test whether the candidate fulfils a set of predicate conditions.

The short normal form is more appropriate for predicate expressions. It enables more efficient retrieval testing because there are fewer conditions to test. However, there is no loss of specificity because any candidate that fulfils the conditions of the short normal form inevitably fulfils the conditions of the long normal form.

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7.8.2.4.3.3 Building long and short normal forms

The most effective approach to building either normal form is to start by generating the long normal form. If the short normal form is required this can then be derived by removing redundant defining relationships.

Generating a long form to derive short form may appear counterintuitive. However, there are three reasons why this approach is strongly recommended.

- The process of generating either normal form includes steps that test subsumption between different parts of an expression. The long normal form is required as the predicate for these tests.
- A single approach requires only one algorithm to be specified and implemented. This eases maintenance and reduces the risks of inconsistencies developing between the two transforms.
- The short form is needed less frequently than the long form because it is used in predicates (e.g. queries) rather than in candidate instances (e.g. expression in a record). An approach that optimises long form generation is therefore advantageous.

The next section sets out the general approach to generation of the long and short normal forms for a concept definition. References to individual concepts in the source expression are replaced by normal form concept definitions when generating the normal form of an expression.

7.8.2.4.3.4 Concept definitions in normal forms

7.8.2.4.3.4.1 Long Normal Form

A form which when applied to a candidate expression allows effective computation of whether it is subsumed by a predicate expression.

Supertype view: **Proximal Primitive Supertypes**

- For fully defined concepts compute the proximal primitives
- For primitive concepts treat the concept itself as the proximal primitive supertype:
  - Rationale: This primitive concept must be present to enable the candidate expression to be subsumed by a predicate expression that includes this particular primitive concept.

Attribute view: **All Defining Relationships**

- For all concepts (whether fully defined or primitive) include all non-subtype defining relationships, irrespective of whether these are also present in the union of the definitions of the primitive supertypes:
  - Rationale: An expression may be subsumed by a concept that does not share all its proximal primitive supertypes. Some of the characteristics specified as part of other primitives in the candidate expression may also be present in the candidate expression.

7.8.2.4.3.4.2 Short Normal Form

A form which when applied to a predicate expression allows effective computation of whether a candidate expression is one of its subtypes.

Supertype view: **Proximal Primitive Supertypes**

- For fully defined concepts compute the proximal primitives
- For primitive concepts treat the concept itself as the proximal primitive supertype:
  - Rationale: As for long form see Long Normal Form on page 526.

Attribute view: **Differential Defining Relationships** (compared to supertype view)

- For primitive concepts there are no differential defining relationships because the primitive concept is its own proximal primitive supertype. Therefore in predicate normal form the attribute view is empty for primitive concepts.
- For fully defined concepts the differential form only includes defining relationships, and relationship groups, that are more specific than those present in the union of the definitions of the primitive supertypes:
Rationale: Each element in the predicate specifies an additional test to be applied to candidate expressions. However these additional tests are superfluous because:

- The candidate expression cannot be subsumed by the predicate unless every candidate primitive supertype is subsumed by at least one predicate primitive supertype;
- If this condition is met, then all defining relationships or relationship groups or the candidate primitive supertypes are inevitably also shared by the candidate expression.

7.8.2.4.3.4.3 Examples of normal form concept definitions

7.8.2.4.3.4.3.1 Normal form of a fully-defined concept with no intermediate primitives

The concept | fracture of femur | is fully defined and its proximal primitive supertype is a high-level primitive. This proximal primitive does not share any of the defining relationships of the concept itself. Therefore, the long and short normal forms of | fracture of femur | are identical because all its defining relationships differ from those of its primitive supertype.

Table 243: Normal form of a fully-defined concept with no intermediate primitives

<table>
<thead>
<tr>
<th>Concept</th>
<th>71620000</th>
<th>fracture of femur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>116680003</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>{116676008</td>
<td>associated morphology</td>
</tr>
</tbody>
</table>
| | ,363698007 | finding site | = 71341001 | bone structure of femur | }
| Long NF | 64572001 | disease | :
| | {116676008 | associated morphology | = 72704001 | fracture |
| | ,363698007 | finding site | = 71341001 | bone structure of femur | }
| Short NF | 64572001 | disease | :
| | {116676008 | associated morphology | = 72704001 | fracture |
| | ,363698007 | finding site | = 71341001 | bone structure of femur | }

Using the long normal form

To test if | fracture of femur | is subsumed by another expression the long normal form is used as the candidate. If all the conditions of a predicate expression are satisfied by this candidate then | fracture of femur | is subsumed by this predicate.

- The concept | fracture of femur | is subsumed by any normal form predicate expression with a focus concept | disease | (or a supertype of "diseases" such as | clinical finding |) unless the predicate expression also has conditions that do not subsume | morphology | = | fracture | and | finding site | = | bone structure of femur |.

Using the short normal form

To test if | fracture of femur | subsumes another expression the short normal form is used as the predicate. Any candidate expression that satisfies all the conditions of this candidate is subsumed by | fracture of femur |.

- The concept | fracture of femur | subsumes any concept that is a | disease | with a morphology subsumed by "fracture" and a | finding site | subsumed by | bone structure of femur |:
  - The candidate expression | disease | with | morphology | = | fracture, open | and | finding site | = | structure of neck of femur | is thus subsumed.

A high-level primitive is a concept that is primitive and has no fully defined supertypes.
7.8.2.4.3.4.3.2 Normal forms of a Primitive concept

The concept "asthma" is primitive so it is its own proximal primitive supertype. The long normal form therefore consists of the concept itself and all its defining relationships. The short normal form is simply the concept itself.

Table 244: Normal forms of a Primitive concept

<table>
<thead>
<tr>
<th>Concept</th>
<th>Definition (distributed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>116680003</td>
</tr>
<tr>
<td></td>
<td>116680003</td>
</tr>
<tr>
<td></td>
<td>116676008</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concept</th>
<th>Long NF (candidate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>116676008</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concept</th>
<th>Short NF (predicate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>195967001</td>
</tr>
</tbody>
</table>

Using the long normal form

To test if "asthma" is subsumed by another expression the long normal form is used as the candidate. If all the conditions of a predicate expression are satisfied by this candidate then "asthma" is subsumed by this predicate.

- The concept "asthma" is subsumed by any normal form predicate expression with a focus concept that is "asthma" (or a supertype of "asthma" such as | disease | or | clinical finding |) unless the predicate expression also has conditions that do not subsume | morphology | = | obstruction | and | finding site | = | bronchial structure |.

Using the short normal form

To test if "asthma" subsumes another expression the short normal form is used as the predicate. Any candidate expression that satisfies all the conditions of this candidate is subsumed by | asthma |.

- The concept "asthma", only subsumes expressions that explicitly include a focus concept that is either "asthma" or a subtype of | asthma |:
  - The candidate expression | disease | with | morphology | = | obstruction | and | finding site | = | bronchial obstruction | is not subsumed by | asthma |.

7.8.2.4.3.4.3.3 Normal form of a fully-defined concept with an intermediate primitive

The concept | allergic asthma | is fully defined but its proximal primitive supertype ("asthma") is an intermediate primitive. The long normal form consists of the proximal primitive supertype and all the defining relationships of | allergic asthma |. The short normal form is the same proximal primitive but the only relationship included is | due to | = | allergic reaction | as this is its only difference from the definition of the primitive.

---

27 An intermediate primitive is a concept that is primitive but which has fully-defined supertypes and subtypes.
### Table 245: Normal form of a fully-defined concept with an intermediate primitive

<table>
<thead>
<tr>
<th>Concept</th>
<th>389145006</th>
<th>allergic asthma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(distributed)</td>
<td>116680003</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>,116680003</td>
<td>is a</td>
</tr>
<tr>
<td></td>
<td>,42752001</td>
<td>due to</td>
</tr>
<tr>
<td></td>
<td>,116676008</td>
<td>associated morphology</td>
</tr>
<tr>
<td></td>
<td>,363698007</td>
<td>finding site</td>
</tr>
<tr>
<td>Long NF</td>
<td>195967001</td>
<td>asthma</td>
</tr>
<tr>
<td>(candidate)</td>
<td>42752001</td>
<td>due to</td>
</tr>
<tr>
<td></td>
<td>,116676008</td>
<td>associated morphology</td>
</tr>
<tr>
<td></td>
<td>,363698007</td>
<td>finding site</td>
</tr>
<tr>
<td>Short NF</td>
<td>195967001</td>
<td>asthma</td>
</tr>
<tr>
<td>(predicate)</td>
<td>42752001</td>
<td>due to</td>
</tr>
</tbody>
</table>

**Using the long normal form**

To test if | allergic asthma | is subsumed by another expression the long normal form is used as the candidate. If all the conditions of a predicate expression are satisfied by this candidate then | allergic asthma | is subsumed by this predicate.

- The concept | allergic asthma | is subsumed by any normal form predicate expression with a focus concept that is “asthma” (or a supertype of “asthma” such as | disease | or | clinical finding |) unless the predicate expression also has conditions that do not subsume | morphology | = | obstruction | and | finding site | = | bronchial structure | and | due to | = | allergic reaction |

**Using the short normal form**

To test if | allergic asthma | subsumes another expression the short normal form is used as the predicate. Any candidate expression that satisfies all the conditions of this candidate is subsumed by | allergic asthma |.

- The concept | allergic asthma |, only subsumes expressions that explicitly include a focus concept that is either “asthma” or a subtype of “asthma” and the attribute | due to | = | allergic reaction |:
  - The candidate expression | disease | with | morphology | = | obstruction | and | finding site | = | bronchial obstruction | and | due to | = | allergic reaction | is not subsumed by | allergic asthma |.

7.8.2.4.3.4.3.4 Normal form of a fully-defined concept with fully-defined attribute values

The concept | neoplasm of right lower lobe of lung | is fully defined with a high-level proximal primitive ( | disease |). The long normal form consists of the proximal primitive supertype and all the defining relationships of | neoplasm of right lower lobe of lung |. However, the value of the | finding site | attribute ( | structure of right lower lobe of lung |) is itself fully defined. Therefore, this value is also transformed to normal form ( | structure of lower lobe of lung | with | laterality | = | right |). The short normal form is the same because all of the defining relationships differ from those of the proximal primitive supertype.

The standard SNOMED CT distribution format does not support explicit nesting of definitions. The normal forms described in this require nesting and this is supported by the SNOMED CT expression model. As a result, the normal forms shown here differ from the distributed relationship file and from the canonical table.
Table 246: Normal form of a fully-defined concept with fully-defined attribute values

<table>
<thead>
<tr>
<th>Concept</th>
<th>126716006</th>
<th>neoplasm of right lower lobe of lung</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>116680003</td>
<td>is a</td>
</tr>
<tr>
<td>(distributed)</td>
<td>{116676008</td>
<td>associated morphology</td>
</tr>
</tbody>
</table>
|                   | ,363698007 | finding site | = 266005 | structure of right lower lobe of lung | }
| Long NF (candidate) | 64572001 | disease | :
|                   | {116676008 | associated morphology | = 108369006 | neoplasm |
|                   | ,363698007 | finding site | = |
|                   | (90572001 | structure of lower lobe of lung | :
|                   | 272741003 | laterality | = 24028007 | right | })
| Short NF (predicate) | Same as long form

Using the long normal form

To test if | neoplasm of right lower lobe of lung | is subsumed by another expression the long normal form is used as the candidate. If all the conditions of a predicate expression are satisfied by this candidate then | neoplasm of right lower lobe of lung | is subsumed by this predicate.

- The concept | neoplasm of right lower lobe of lung | is subsumed by any normal form predicate expression with a focus concept that is | disease | (or a supertype of | disease | such as | clinical finding |) unless the predicate expression also has conditions that do not subsume | morphology | = | neoplasm | and | finding site | = | structure of lower lobe of the lung | with | laterality | = | right |.

Using the short normal form

To test if | neoplasm of right lower lobe of lung | subsumes another expression the short normal form is used as the predicate. Any candidate expression that satisfies all the conditions of this candidate is subsumed by | neoplasm of right lower lobe of lung |.

- The concept | neoplasm of right lower lobe of lung |, only subsumes expressions that have a | finding site | that is the "right lower lobe of the lung". However, because this site is normalised an expression that postcoordinates the laterality and the site will also be subsumed.

7.8.2.4.3.5 Applying normal forms to expressions

The previous section described the manner in which normal form expression transformations are applied to concept definitions. In this section this approach is extended to cover expressions which may contain refinements or qualifications of the released concepts.

7.8.2.4.3.5.1 Normal form of a simple expression

The simplest expression consists of a reference to a single concept (i.e. a single conceptId with no refinements). The normal forms for this are the same as those for the concept definition. Table 247 illustrates this using one of the examples used in the previous section.

Table 247: A simple expression with no refinements

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>71620000</td>
</tr>
</tbody>
</table>
7.8.2.4.3.5.2 Normal forms of expressions with refinements

If a refinement specifies a more specific (subtype) value for one of the defining relationships of the focus concept, the refined value simply replaces the value in the definition. The examples in Table 248 and Table 249 illustrate this for refinements to either site or the morphology.

Table 250 extends this example to include refinements to both the morphology and site. In all these examples while the refinements were not grouped in the close-to-user form, the transformation groups the site and morphology. This occurs because the refined values are replacing the defining values that were grouped.

Table 248: An expression with a refinement to finding site

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>71620000</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
<tr>
<td>Normal-form</td>
<td>64572001</td>
</tr>
<tr>
<td>(short or long)</td>
<td>{116676008</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
</tbody>
</table>

Table 249: An expression with a refinement to the nature of the morphology

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>71620000</td>
</tr>
<tr>
<td></td>
<td>116676008</td>
</tr>
<tr>
<td>Normal-form</td>
<td>64572001</td>
</tr>
<tr>
<td>(short or long)</td>
<td>{116676008</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
</tbody>
</table>

Table 250: An expression with a refinement to the morphology and site

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>71620000</td>
</tr>
<tr>
<td></td>
<td>116676008</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
</tbody>
</table>
7.8.2.4.3.5.3 Normal forms of expressions with qualifiers

Table 251 shows the effect of applying a qualifier Attribute to a concept. As this is a qualifier it is not present in the definition and there is no indication whether this qualifier should be grouped with the site and morphology. Therefore, the qualifier remains ungrouped in the normal form.

Table 251: An expression with a qualifier applied to specify severity

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>71620000</td>
</tr>
<tr>
<td></td>
<td>246112005</td>
</tr>
<tr>
<td>Normal-form</td>
<td>64572001</td>
</tr>
<tr>
<td>(short or long)</td>
<td>246112005</td>
</tr>
<tr>
<td></td>
<td>{116676008</td>
</tr>
<tr>
<td></td>
<td>,363698007</td>
</tr>
</tbody>
</table>

7.8.2.4.3.5.4 Normal forms of expressions with nested refinements

A refinement may be applied to a value in the expression rather than directly to the focus concept. Laterality is the most obvious example of a nested refinement and is used for all the illustrations in this section. However, nesting also occurs with other expressions, notably expressions that include explicit representations of context (see Expressions that include context and Normal forms and the context model).

Table 252 illustrates this by showing the effect of applying laterality to refinement to the finding site. The resulting normal form groups the finding site and its nested laterality refinement, with the morphology because this sub-expression is a valid refinement of the defined site.

Table 252: An expression with refinement of the laterality (nested with body structure)

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nested refinement of laterality</td>
<td>71620000</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
</tr>
<tr>
<td>Normal-form</td>
<td>64572001</td>
</tr>
<tr>
<td>(short or long)</td>
<td>{116676008</td>
</tr>
<tr>
<td></td>
<td>,363698007</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
</tr>
</tbody>
</table>
7.8.2.4.3.5.5 Normal forms representations of laterality

Table 252 used laterality as an illustration of nested refinement. However, lateralised findings or procedures may be represented in several different ways.

As shown in Table 253 applying laterality as a nested refinement to finding that has defined site requires restatement of the finding site (even though this value is unchanged). This redundancy is removed when the expression is transformed to its normal form.

Table 253: Nested laterality refinement

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>47933007</td>
</tr>
<tr>
<td>Normal-form (short or long)</td>
<td>22253000</td>
</tr>
</tbody>
</table>

Table 254 shows an alternative that is available for sites where there is a concept that is specific for lateralised body structure. In this example, the value | left foot | is a valid refinement of finding site because it is a subtype of | foot structure |.

The concept | left foot | is fully defined and includes the defining relationship | laterality | = | left |. Therefore, the normal form of this expression is identical to the nested laterality example.

Table 254: Alternative expression refinements representing lateralisation

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateralised body structure</td>
<td>47933007</td>
</tr>
<tr>
<td>Normal-form (short or long)</td>
<td>22253000</td>
</tr>
</tbody>
</table>

Table 255 illustrates an alternative that is available in a limited number of cases where a concept exists that precoordinates a finding with a lateralised finding site. The example shown here is artificial because the concept | pain in left foot | is not present in SNOMED CT and there are no plans to add such concepts. However, some concepts of this nature do exist and their definitions when transformed result in the same normal form as the expression shown in the earlier example.

Table 255: Laterality precoordinated in a finding

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>precoordinated expression</td>
<td>&lt;some-id&gt;</td>
</tr>
</tbody>
</table>
Table 256 shows a close-to-user form in which laterality has been applied directly to a finding. For the purposes of computing equivalence and subsumption the concept model always treats laterality as applying to body structures rather than directly to findings or procedures. However, a simple transform rule allows a close-to-user expression consisting of a finding with a direct laterality refinement to be normalised. This normalisation rule specifies that the laterality refinement is applied to all lateralisable sites in the normalised expression. The end result of this transform is exactly the same normal form as results from other approaches. The same approach can be used for procedures.

Table 256: Laterality applied directly to a finding

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user expression</td>
<td>47933007</td>
<td>foot pain</td>
</tr>
<tr>
<td>Normal-form (short or long)</td>
<td>22253000</td>
<td>pain</td>
</tr>
</tbody>
</table>

Conclusions on approaches to laterality

In principle, all four of the representations shown in Table 257 are acceptable and all of them can be transformed to the same normal form. However, laterality is only precoordinated with a limited number of findings, procedures and body structures. Therefore, the only representations that provide comprehensive coverage are the direct form (3) and the nested normal form (4). Superficially the normal form seem most appropriate but based on a more detailed the direct close-to-user form (3) is recommended for recording, storage and communication.

Table 257: Alternative representations of laterality

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. precoordinated</td>
<td>&lt;some-id&gt;</td>
<td>pain in left foot</td>
</tr>
<tr>
<td>2. Laterised body structure value</td>
<td>47933007</td>
<td>foot pain</td>
</tr>
<tr>
<td>3. Laterality applied directly to finding</td>
<td>47933007</td>
<td>foot pain</td>
</tr>
</tbody>
</table>
The direct close-to-user form (3) has three significant advantages when compared to the normal form:

- Where multiple sites are involved (see Table 261) or where multiple separately grouped actions apply to the same site, this approach avoids the need to specify laterality separately for each site\(^{28}\). Routinely presenting users with a choice of which sites are to be lateralised is likely to hinder acceptance.
- The nested approach "locks-in" the site value(s) and groupings present in the definition at the time the expression is authored. If a future release enhances or corrects that definition, instances of the same refinement before and after a change will not compute as equivalent. However, if laterality is applied directly, the derived normal forms will be identical irrespective of when the expression was created.
- The resulting expressions are simpler and more compact and the transform rules mean no information is lost.

7.8.2.4.3.5.6 Normal forms of expressions including refinements of a Primitive concept

When the focus concept is primitive or has an intermediate primitive supertype the normal and close to user forms are less likely to be the same as one another.

Table 258 illustrates the effects of a refinement applied to primitive concepts. The same general rules apply but after the transformation process the same primitive focus concept remains. The short normal form expression is identical to the close-to-user form because the refinement represents the only difference between the long normal form and the definition of the focus concept.

Table 258: An expression that refines a Primitive concept

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Normal-form (short or long)</td>
<td>22253000</td>
<td>pain</td>
</tr>
<tr>
<td></td>
<td>363698007</td>
<td>finding site</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
<td>laterality</td>
</tr>
</tbody>
</table>

\(^{28}\) Only on very rare occasions will a single finding or procedure require separate lateralisation of different sites in its definition. However, support for the direct approach does not preclude the nested approach if it is necessary to associate different laterality refinement with different structures.
Table 259 illustrates the effects of a refinement applied to a concept with an intermediate primitive supertype. The short normal form contains the “due to” Attribute because this differs between the focus concept (allergic asthma) and the primitive supertype (asthma) as when as the causative agent specified in the refinement.

**Table 259: An expression that refines a concept with an intermediate primitive supertype**

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Close-to-user</strong></td>
<td>389145006</td>
</tr>
<tr>
<td></td>
<td>246075003</td>
</tr>
<tr>
<td><strong>Normal-form</strong></td>
<td>195967001</td>
</tr>
<tr>
<td>(long)</td>
<td>246075003</td>
</tr>
<tr>
<td></td>
<td>.42752001</td>
</tr>
<tr>
<td></td>
<td>{116676008</td>
</tr>
<tr>
<td></td>
<td>.363698007</td>
</tr>
<tr>
<td><strong>Normal-form</strong></td>
<td>195967001</td>
</tr>
<tr>
<td>(short)</td>
<td>246075003</td>
</tr>
<tr>
<td></td>
<td>.42752001</td>
</tr>
</tbody>
</table>

7.8.2.4.3.5.7 Normal forms for refinements of concepts with more complex definitions

Some concept definitions include multiple instances of the same defining attribute. Usually these are grouped separately, for example to represent a procedure that examines one body structure and removes another. When refinements are applied to these concepts a question arises as to which value is to be refined. In most cases, the transform rules allow this to be determined without requiring the close-to-user expression to explicitly state the instance that is being refined. The transform rule states that an ungrouped refinement applies to any instance of the appropriate attribute that subsumes it.

Table 260 shows the effect of this transform rule when the refinement of procedure site is a subtype of one of the defining site attributes but not of the other one. The appropriate value is refined and the other value is unchanged.

**Table 260: An expression that refines one of two sites**

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Close-to-user</strong></td>
<td>116028008</td>
</tr>
<tr>
<td></td>
<td>363704007</td>
</tr>
<tr>
<td><strong>Normal-form</strong></td>
<td>71388002</td>
</tr>
<tr>
<td>(short or long)</td>
<td>{260686004</td>
</tr>
<tr>
<td></td>
<td>.363704007</td>
</tr>
<tr>
<td></td>
<td>{181463001</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
</tr>
<tr>
<td></td>
<td>{260686004</td>
</tr>
<tr>
<td></td>
<td>.363704007</td>
</tr>
</tbody>
</table>

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Table 261 shows a case in which a refinement of laterality is applicable to both the sites in the definition of a procedure (i.e. both ovarian structure and fallopian tube structure are lateralisable). Therefore, the resulting normal form shows this lateralisation applied to both structures.

### Table 261: An expression that lateralises multiple sites

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>116028008</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
</tr>
<tr>
<td>Normal-form</td>
<td>71388002</td>
</tr>
<tr>
<td>(short or long)</td>
<td>(260686004</td>
</tr>
<tr>
<td></td>
<td>,363704007</td>
</tr>
<tr>
<td></td>
<td>(15497006</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
</tr>
<tr>
<td></td>
<td>(260686004</td>
</tr>
<tr>
<td></td>
<td>,363704007</td>
</tr>
<tr>
<td></td>
<td>(31435000</td>
</tr>
<tr>
<td></td>
<td>272741003</td>
</tr>
</tbody>
</table>

In a few cases, a refinement that is valid for more than one attribute may need to be applied specifically to just one of those attributes. In these cases, the close to user form should include an attribute group with at least one other attribute from the appropriate group in the concept definition. This allows the distinction to be made by the transform rules for attribute group merging.

Otherwise, the close-to-user form should not repeat groups or additional attributes that are unchanged from the definition. These attributes and groups are derivable by the normal form transformation. However, if they are included in the stored or communicated close-to-user form they are "locked-in", which may impair equivalence testing across releases.

7.8.2.4.3.5.8 Normal forms and the context model

The SNOMED CT context model is designed to allow equivalence and subsumption testing to take account of difference in the context in which a finding or procedure concept is used. The same general transform rules apply to concepts that include explicit statements of context. However, in addition to these rules the default context to a finding or procedure expression that has no explicitly stated context. This additional step allows the equivalence and subsumption tests to be applied in exactly the same way to expressions without stated context and to those with a stated context.

Table 262 shows an expression in which the focus concept family history of disorder has a definition that includes stated context. The disorder allergy to nuts is stated as the associated finding. Both these concepts are transformed to their respective normal forms

- The normal form of family history of disorder is a context wrapped in which "person in the family" is the value of "subject relationships context";
- The normal form of allergy to nuts (106190000 allergy with causative agent | = | nut |) becomes the nested value of the associated finding | Attribute of the context wrapper.

### Table 262: An expression that includes specific context information

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>281666001</td>
</tr>
<tr>
<td></td>
<td>246090004</td>
</tr>
</tbody>
</table>
Table 263 shows an expression that does not state its context. Applying the transform rules the normal form expression is generated as in previous examples. When the additional step to apply the default context is carried out a default context-wrapper (in "the subject of the record" at "current or specified time") is created and the clinical expression becomes the clinical-kernel within this wrapper.

In this case, the morphology and finding site Attributes are omitted as the values of these attributes are the same as those defined for the Primitive concept 195967001 | asthma |.

**Table 263: Applying default context to an expression**

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-to-user</td>
<td>195967001</td>
</tr>
<tr>
<td>Normal-form</td>
<td>243796009</td>
</tr>
<tr>
<td><em>with context</em></td>
<td>(short or long)</td>
</tr>
<tr>
<td>(long)</td>
<td>(246090004</td>
</tr>
<tr>
<td></td>
<td>(195967001</td>
</tr>
<tr>
<td></td>
<td>246112005</td>
</tr>
</tbody>
</table>
|                 | {116676008 | associated morphology | = 26036001 | obstruction | |)
|                 | .363698007 | finding site | = 955009 | bronchial structure | ) |
|                 | .408729009 | finding context | = 410515003 | known present | |
|                 | .408731000 | temporal context | = 410512000 | current or specified | |
|                 | .408732007 | subject relationship context | = 303071001 | person in the family | ) |
| Normal-form     | 243796009 | situation with explicit context | : |
| *with context*  | (short) |
| (long)          | (246090004 | associated finding | = |
|                 | (195967001 | asthma | : |
|                 | 246112005 | severity | = 255604002 | mild | ) |
|                 | .408729009 | finding context | = 410515003 | known present | |
|                 | .408731000 | temporal context | = 410512000 | current or specified | |
|                 | .408732007 | subject relationship context | = 410604004 | subject of record | ) |

7.8.2.4.3.5.9 Normal forms that take account of the information model

When *expressions* are used in record systems or electronic communication there is often some surrounding contextual information that may affect the way in which the meaning of the *expression*...
should be interpreted. For example, a reference to a disease within a part of a record dedicated to “family history” should not be interpreted as a diagnosis of the patient. This is a complex area because many different information models and conventions may apply in different systems. However, some general rules have been identified and can be defined in relation to standard reference models (e.g. the HL7 Version 3 Reference Information Model).

The general rules are that contextual information apparent in the surrounding information model should be separated from the SNOMED CT expression before it is normalised. The expression is then transformed to a normal form expression. If the resulting normal form contains a context wrapper, this is separated from the clinical-kernel. A new context wrapper is derived by merging the information model context and any context stated in any original context wrapper. The SNOMED CT default context is only applied to fill in the gaps where neither the information model nor the original wrapper provides a definitive value for a context Attribute. The clinical-kernel is then nested in the new context wrapper.

The examples in this section cover two of the most common areas in which context from the information model affects the meaning of a contained expression in a predictable and processable way.

Table 264 illustrates the fact that when an expression representing a procedure exists in an information construct that represents a request, the default procedure context value done is overridden by the information model. Thus the resulting normal form expressions show the procedure context value “requested”.

Table 264: Information model representation of context affecting default context

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information model</td>
<td>Request</td>
</tr>
<tr>
<td>• Represented by the information model for example HL7 Observation.moodCode=&quot;RQO&quot;.</td>
<td></td>
</tr>
<tr>
<td>113075003</td>
<td>creatinine measurement, serum</td>
</tr>
<tr>
<td>Close-to-user with context</td>
<td>400999005</td>
</tr>
<tr>
<td>363589002</td>
<td>associated procedure =113075003</td>
</tr>
<tr>
<td>Normal-form with context (long)</td>
<td>243796009</td>
</tr>
<tr>
<td>363589002</td>
<td>associated procedure</td>
</tr>
<tr>
<td>(252144003 252144003 :</td>
<td></td>
</tr>
<tr>
<td>116686009</td>
<td>has specimen = ( 123038009</td>
</tr>
<tr>
<td>370133003</td>
<td>specimen substance = 67922002</td>
</tr>
<tr>
<td>.246093002</td>
<td>component = 15373003</td>
</tr>
<tr>
<td>.408730004</td>
<td>procedure context = 385644000</td>
</tr>
<tr>
<td>.408731000</td>
<td>temporal context = 410512000</td>
</tr>
<tr>
<td>.408732007</td>
<td>subject relationship context = 410604004</td>
</tr>
<tr>
<td>Normal-form with context (short)</td>
<td>243796009</td>
</tr>
<tr>
<td>363589002</td>
<td>associated procedure =113075003</td>
</tr>
<tr>
<td>408730004</td>
<td>procedure context = 385644000</td>
</tr>
<tr>
<td>.408731000</td>
<td>temporal context = 410512000</td>
</tr>
<tr>
<td>.408732007</td>
<td>subject relationship context = 410604004</td>
</tr>
</tbody>
</table>
Table 265 illustrates that when the information model applies a value to a measurement procedure the resulting statement expresses a finding (i.e. the finding of a specific value as a result of that procedure).

If the requirement is to distinguish between requested and completed procedures, the default procedure context-wrapper could be applied. This would (correctly) assert that the procedure had been done (| procedure context | = | done |).

However, if the requirement is to distinguish between goals and actual measured values the default finding context-wrapper is more appropriate. This would indicate that this was a finding that was known to be present (| finding context | = | known present |).

Table 265: Measurement procedures with values assigned in the information model

<table>
<thead>
<tr>
<th>Expression view</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information model</td>
<td>Report</td>
</tr>
<tr>
<td></td>
<td>• Represented by the information model for example HL7 Observation.moodCode=&quot;EVN&quot;.</td>
</tr>
<tr>
<td></td>
<td>113075003</td>
</tr>
<tr>
<td></td>
<td>Value = 16 g/L</td>
</tr>
<tr>
<td></td>
<td>• Represented by the information model for example by HL7 Observation.value.</td>
</tr>
</tbody>
</table>
| Normal-form with context (short) | 243796009 | situation with explicit context | :
| | {246090004 | associated finding | = 113075003 | creatinine measurement, serum | |
| | .408729009 | finding context | = 410515003 | known present | |
| | .408731000 | temporal context | = 410512000 | current or specified | |
| | .408732007 | subject relationship context | = 410604004 | subject of record | }
| | Value = 16 g/L |
| | • Represented by the information model for example by HL7 Observation.value. |

7.8.2.4.4 Transforming expressions to normal forms

The process of transforming an expression to a normal form is based on the description logic definitions of the concepts referenced by the expression. Using this approach, expressions that are authored, stored and/or communicated in a relatively informal close-to-user form are logically transformed into a common normalised form. In this normalised form it is possible to apply simple rules to test subsumption between expressions.

The simplest case of a valid close-to-user expression is a single conceptId, and the approach described can be applied to these simple precoordinated expressions, as well as to more complex expressions that include multiple conceptIds and refinements (qualifiers).

The approach to normalisation may be applied to specific expressions but may also be extended to take account of contextual information derived from the information model in which the expression is situated. Therefore, the normal form may include SNOMED CT context information, even if this is not present in the initial SNOMED CT expression.

The algorithm extends earlier work on canonical forms as follow:

- Normalises fully defined values within definitions or expressions producing nested expressions that are fully normalised.
- Merges refinements stated in an expression with definitional relationships present in the definitions of the concepts referenced by the expression.
• The merge process takes account of refinements that may not be grouped or nested in a manner
  that precisely reflects the structure of a current (or future) concept definition;
• This avoids the need to add, store and communicate potentially spurious detail from current
definitions to the expression recorded by a user or software application.
• Takes account of context rules including default context and a preliminary approach to moodCode
  mapping and handling of procedures with values (present in algorithm but not yet easily visible in test
  environment).
• Supports subsumption tests that take account of finding specified with | known absent | finding context.

*Figure 127* illustrates an overview of the process of normalisation of an expression. Subsequent sections
describe the processes shown in this diagram.
7.8.2.4.4.1 Separate information model context

The objective of this process is to separate information associated with an *expression* from the *expression* itself.
Information that is not part of the expression itself, may influence its interpretation. For example, a expression used in an HL7 Observation in goal mood (moodCode="GOL") implies that the finding context | goal | applies to the expression rather than the default value | known present |

If the input is a expression without any information about its use within a specific information model:

- The expression is passed unchanged to the "Normalise expression" process;
- No information model context is passed to the "Manage context" process.

If the input is an HL7 clinical statement (or a similar structure that conveys additional contextual information):

- The expression is separated from the surrounding information model information and is passed to the "Normalise expression" process;
- Relevant surrounding information model information is passed to the "Manage context" process.

The items of surrounding information that are relevant vary according to the information model and the guidelines on its use. For example, if the HL7 clinical statement model is used, any of the following attributes and related classes that are present are relevant to normalisation of the expression in context:

- Act.moodCode;
- Observation.value;
- Act.negationInd;
- Act.uncertaintyCode;
- participation associations or an Act (especially "subject").

The way in which these attributes may affect SNOMED CT context is discussed in Manage context.

Normaliseexpression

Figure 128 illustrates the detailed steps in the process of normalising an expression. This process takes place after separating the expression from any surrounding information model context and before managing context representation in the expression.
**Figure 128: Expression normalisation processes**

7.8.2.4.2.1 Separate focus concepts from refinement

The set of *focus concepts* in the *expression* is passed to the *Normalise focus concepts* process.

If the *expression* contains a *refinement*, this is passed to the *Normalise attribute values in refinement* process.
Table 266: Separate focus concept from refinement

<table>
<thead>
<tr>
<th>Expression</th>
</tr>
</thead>
</table>
| Original expression | 12676007 | fracture of radius |+ 397181002 | open fracture |:
| 272741003 | laterality ||= 7771000 | left |
| 42752001 | due to ||= 297186008 | motorcycle accident |
| Focus Concept | 12676007 | fracture of radius |+ 397181002 | open fracture |
| Refinement | 272741003 | laterality ||= 7771000 | left |
| 42752001 | due to ||= 297186008 | motorcycle accident |

Normalise attribute values in refinement

The value of every attribute specified in the expression refinement (including grouped and ungrouped attributes) is treated as an expression and normalised according to the full set of rules in Normalize expression. To ensure depth-first processing, this recursive process is carried out before any other processing of the expression refinement.

Recursive normalisation should be applied to all values even if they are represented by single conceptIds.

When all attribute values in the expression refinement have been processed, the refinement is passed to the Merge refinement process.

Normalise focus concepts

The set of focus concepts is normalised to generate two separate outputs described in the following sections.

7.8.2.4.2.3.1 The set of normalised definitions of each focus concept

The set of normalised definitions includes a separate normalised definition for each focus concept,

- The normalised definition includes:
  - All ungrouped relationships
  - All relationship groups complete with contained relationships
  - All relationship values are normalised by recursively following the full set of rules described in Concept definitions in normal forms.

Note: Storage of pre-computed normalised form of concept definitions simplifies this process as it removes the requirement for recursive processing of definitions at run time.

The set of normalised definitions is passed to the Merge definitions process.

Table 267: Normalize focus concepts definitions

<table>
<thead>
<tr>
<th>Expression</th>
</tr>
</thead>
</table>
| Original expression | 12676007 | fracture of radius |+ 397181002 | open fracture |:
| 272741003 | laterality ||= 7771000 | left |
| 42752001 | due to ||= 297186008 | motorcycle accident |
| Focus Concepts | 12676007 | fracture of radius |+ 397181002 | open fracture |
7.8.2.4.4.2.3 The non-redundant proximal primitive supertypes of the focus concepts

The non-redundant proximal primitive supertypes of the focus concepts is the set of all primitive supertypes of all the focus concepts with redundant concepts removed.

- A concept is redundant if it is:
  - A duplicate of another member of the set;
  - A supertype of another concept in the set.

The set of proximal primitive supertypes generated by this process is passed to the Create expression process as the focus concepts for the output expression.

**Table 268: Normalize focus concepts definitions**

| Original expression | 12676007 | fracture of radius |+| 397181002 | open fracture |
|                     | 272741003 | laterality ||=| 7771000 | left |
|                     | 42752001 | due to ||=| 297186008 | motorcycle accident |
| Focus Concepts       | 12676007 | fracture of radius |+| 397181002 | open fracture |
| Set of normalised focus concept definitions | 76069003 | disorder of bone |{: | 116676008 | associated morphology ||=| 72704001 | fracture |, | 363698007 | finding site ||=| 23416004 | bone structure of radius |}+| 64572001 | disease |{: | 116676008 | associated morphology ||=| 52329006 | open fracture |
| List of all proximal primitive supertypes | 76069003 | disorder of bone |
|                                         | 64572001 | disease |
| List of non-redundant proximal primitive supertypes | 64572001 | disease |

7.8.2.4.4.2.4 Merge definitions

The set of normalised definitions derived from the Normalize focus concepts process are merged with one another to remove redundancy. Then the normalised refinement is merged with the pre-merged definition to create a single refinement which expresses the full set of definitions and refinements without unnecessary redundancy.

The rules applied to the merger are described below for grouped and ungrouped attributes.

Group merging is completed before applying any ungrouped relationships. This ensures that, where appropriate, ungrouped attributes are applied to the correct groups in the output.
Redundant attributes are not removed until the merger process is complete. This ensures that the full set of attributes is available to allow matching throughout the process of merging.

7.8.2.4.2.4.1 Attribute names and attribute hierarchies

The following sections on merging groups and attributes refer to “name-matched” attributes. Two or more attributes in a definition or expression are “name-matched” if they have the same attribute name.  

- For example, the attribute | procedure site | = | appendix structure | is name-matched by the attribute | procedure site | = | entire femur |.

However, consideration also needs to be given to hierarchical relationships between different "attribute names". For example, | procedure site - direct | and | procedure site - indirect | are subtypes of | procedure site |.

The simplest approach that can be consistently applied is to treat attributes that have subsumed names as name-matched for the purposes of group and value merging. The more specific attribute name is then applied to the merged attribute in the target definition. This means that the same rules apply for merging the values of | procedure site | and | procedure site - direct | as apply to mergers of attributes with identical names and that the name | procedure site - direct | would then be applied to any values that were merged in this way.

Progress note

Review of a number of practical examples suggests that there may be some unexpected consequences of this approach. For this reason, while the issues that arise are studied further, implementers are recommended only to merge literal name-matched attributes.

Some potential issues are noted here

As definitions are refined over time there will be more use of the specific | procedure site - indirect | and | procedure site - direct |. Should pre-existing refinements to the more general | procedure site | be assigned to whichever of the more specific attributes has a value that subsumes the refined value?

If this rule is applied to some combined procedures then the merger collapses some existing definitions that contain both a | procedure site | and a | procedure site - direct | so that only one of these attributes remains. This will become less of an issue as | procedure site - indirect | is applied more widely.

7.8.2.4.2.4.2 Merging groups

- If a group in one definition meets the following criteria in relation to a group in the other definition then the groups are merged:
  - At least one attribute in one of the groups is name-matched by an attribute in the other group.
  
  and

- For each name-matched pair of attributes, the value of that attribute in one group either subsumes or is identical to the value of the name-matched attribute in the other group;
- Groups that meet the criteria for merging are merged by adding all attributes present in both source groups to the same group in the merged target definition;
- Groups that cannot be merged are created as separate groups in the target definition.

Note that these conditions allow additional attributes that are not name-matched to be present in either of the candidate groups. They also allow values of name-matched attributes to be subsumed in different directions between the two groups (i.e. do not require the entire of one group to be subsumed the other group).

---

29 The words "attribute" and "attribute name" are used here as documented in the SNOMED CT guide to the "Abstract Logical Models and Representation Forms". In SNOMED CT distribution files a "defining relationship" is equivalent to this use of the word "attribute" and a "relationship type" represents an "attribute name".
<table>
<thead>
<tr>
<th>Groups to merge</th>
<th>Result</th>
</tr>
</thead>
</table>
| **Group 1** 363704007 | procedure site |= 421235005 | structure of femur |,  
363700003 | direct morphology |= 72704001 | fracture |  
**Group 2** 260686004 | method |= 129371009 | fixation - action |,  
424226004 | using device |= 31031000 | Orthopedic internal fixation system, device | |
| **No match, no merge** **Group 1** 363704007 | procedure site |= 421235005 | structure of femur |,  
363700003 | direct morphology |= 72704001 | fracture |  
**Group 2** 260686004 | method |= 129371009 | fixation - action |,  
424226004 | using device |= 31031000 | Orthopedic internal fixation system, device | |
| **Attribute name match, but values don’t match and are not subsumed in any direction (’radius’ and ‘fibula’), no merge** **Group 1** 363698007 | finding site |= 62413002 | radius |,  
116676008 | associated morphology |= 72704001 | fracture |  
**Group 2** 363698007 | finding site |= 87342007 | fibula |,  
116676008 | associated morphology |= 72704001 | fracture | |
| **Attribute name match, ‘distal radius’ is subsumed by ‘radius’, merged groups.** **Group 1** 363698007 | finding site |= 62413002 | radius |,  
116676008 | associated morphology |= 72704001 | fracture |  
**Group 2** 363698007 | finding site |= 87342007 | distal radius |,  
116676008 | associated morphology |= 72704001 | fracture | |

* Redundant elements will be removed in later in the process

7.8.2.4.2.4.3 Merging ungrouped attributes

- If an ungrouped attribute in one definition is name-matched by a grouped attribute in the other definition, this attribute is merged according to the following rules:
  - If the value of the ungrouped attribute subsumes the value of the name-matched grouped attribute:
    - omit the ungrouped attribute from the target definition.
  - If the value of the grouped attribute subsumes the value of the name-matched grouped attribute:
• add the ungrouped attribute to the group containing the matching grouped attribute in the target
definition.
• if this condition is met by multiple groups:
  • add the ungrouped attribute to all groups that meet this condition.

• If the value of the name-matched grouped and ungrouped attributes are disjoint:
  • add the ungrouped attribute as an ungrouped attribute in the target expression.

• If an ungrouped attribute is name-matched with an ungrouped attribute in the other definition this
attribute is merged according to the following rules:
  • If the value of one of the name-matched attributes subsumes the other value:
    • include the attribute with the most specific value (not grouped);
    • omit the attributed with the less specific value.
  • If the value of the name-matched attributes are identical:
    • Include one and omit the other.
  • If neither of the of the two preceding conditions apply:
    • include both attributes (not grouped).

• If an attribute is ungrouped in one expression and there is no name-matched attribute in the other
definition:
  • include the attribute (not grouped).

Table 270: Merging ungrouped attributes

<table>
<thead>
<tr>
<th>Result</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Ungrouped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute name match, ‘distal radius’ is subsumed by ‘radius’, merged groups. Ungrouped attribute does not match. Not merged.</td>
<td>363698007</td>
<td>363698007</td>
<td>42752001</td>
</tr>
<tr>
<td>Group 1</td>
<td>finding site</td>
<td>finding site</td>
<td>due to</td>
</tr>
<tr>
<td>62413002</td>
<td>87342007</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>radius</td>
<td>distal radius</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>72704001</td>
<td>72704001</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>fracture</td>
<td>fracture</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>116676008</td>
<td>116676008</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>associated morphology</td>
<td>associated morphology</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>87342007</td>
<td>72704001</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>fracture</td>
<td>fracture</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>363698007</td>
<td>363698007</td>
<td>42752001</td>
<td></td>
</tr>
<tr>
<td>finding site</td>
<td>finding site</td>
<td>due to</td>
<td></td>
</tr>
<tr>
<td>62413002</td>
<td>87342007</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>radius</td>
<td>distal radius</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>72704001</td>
<td>72704001</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>fracture</td>
<td>fracture</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>116676008</td>
<td>116676008</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>associated morphology</td>
<td>associated morphology</td>
<td>motorcycle accident</td>
<td></td>
</tr>
<tr>
<td>87342007</td>
<td>72704001</td>
<td>297186008</td>
<td></td>
</tr>
<tr>
<td>fracture</td>
<td>fracture</td>
<td>motorcycle accident</td>
<td></td>
</tr>
</tbody>
</table>
Attribute name match, 'distal radius' is subsumed by 'radius', merged groups. Ungrouped attribute matches name and value. Merged.

<table>
<thead>
<tr>
<th>Group 1</th>
<th></th>
</tr>
</thead>
</table>
| 363698007 | finding site |= 62413002 | radius |,
| 116676008 | associated morphology |= 72704001 | fracture |
| Group 2          |                   |
| 363698007 | finding site |= 87342007 | distal radius |,
| 116676008 | associated morphology |= 72704001 | fracture |
| Ungrouped        |                   |
| 116676008 | associated morphology |= 72704001 | fracture |

* Redundant elements will be removed in later in the process

7.8.2.4.4.2.4.4 Remove redundant elements from the merged definition

Check each group in the target definition and, within that group, compare the values of any name-matched attributes.

- If an attribute in the group has a value that subsumes the value of another name-matched attribute in the same group, remove that attribute from this group in the target definition.

Check the ungrouped set of attributes.

- If any ungrouped attribute has a value that subsumes the value of a name-matched attribute, remove this ungrouped attribute from the target definition.

Note

The removal of redundancies described only applies to name-matched pairs of attributes. It does not affect attributes that are redundant only because they are present in the definitions of the primitive focus concepts. Supertype ( | is a |) relationships are ignored during this stage of processing.

Table 271: Removing redundant elements

<table>
<thead>
<tr>
<th>Merged definitions with redundancy</th>
<th>Redundancy removed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td><strong>Group 1</strong></td>
</tr>
</tbody>
</table>
| 363698007 | finding site |= 62413002 | radius |,
| 116676008 | associated morphology |= 72704001 | fracture |

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7.8.2.4.4.2.4.5 Completion of the definition merging

Once the focus concept definitions have been merged, the target definition is passed to the Merge refinement process.

7.8.2.4.4.2.5 Merge refinement

The normalised expression refinement from the Normalise attribute values in refinement process is merged with the combined definition from the Merge definitions process. The rules for this process are the same as those for merging definitions.

Normalisation of laterality

If an attribute representing a value for 272741003 | laterality | is present in the refinement and is applied to a focus concept that is not subsumed by 123037004 | body structure |, the laterality attribute should be applied to any and every lateralisable | body structure | specified in the resulting refinement.

Table 272: Normalisation of laterality

<table>
<thead>
<tr>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Original expression</strong></td>
</tr>
</tbody>
</table>
| 12676007 | fracture of radius |:
| 272741003 | laterality |= 7771000 | left |
| **Normalised expression**   |
| before laterality normalisation |
| 76069003 | disorder of bone |:{
| 116676008 | associated morphology |= 72704001 | fracture |,
| 363698007 | finding site |= 23416004 | bone structure of radius |},
| 272741003 | laterality |= 7771000 | left |
| **Normalised expression**   |
| after laterality normalisation |
| 76069003 | disorder of bone |:{
| 116676008 | associated morphology |= 72704001 | fracture |,
| 363698007 | finding site |= 23416004 | bone structure of radius |},
| 272741003 | laterality |= 7771000 | left |

Normalisation of non-context attributes applied in a context wrapper

If the focus concept is subsumed by 243796009 | situation with explicit context | and any attributes other than valid context attributes 30 are present in the refinement, these attributes are applied as additional refinement of the value of the 246090004 | associated finding | or 363589002 | associated procedure | attribute.

7.8.2.4.4.2.5.3 Completion of the definition merging

Once the refinement has been merged the resulting final refinement is passed to the Create expression process.

7.8.2.4.4.2.6 Create expression

The create expression process combines the proximal primitive supertypes from the Normalise focus concepts process (as the new focus concepts) - with the refinement derived from the Merge refinement process.

The resulting expression is now fully normalised but context information may need to be adjusted or applied by the Manage context process.

---

30 The only valid context attributes are: 246090004 | associated finding |, 363589002 | associated procedure |, 2470590016 | finding context |, 2470591017 | procedure context |, 2470592012 | temporal context | and 2470593019 | subject relationship context |.
Table 273: Normalize focus concepts definitions

<table>
<thead>
<tr>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>List of non-redundant proximal primitive supertypes</strong></td>
</tr>
<tr>
<td><strong>Group 1</strong></td>
</tr>
<tr>
<td><strong>Resulting normalised expression</strong></td>
</tr>
<tr>
<td>64572001</td>
</tr>
<tr>
<td>363698007</td>
</tr>
<tr>
<td>116676008</td>
</tr>
<tr>
<td>64572001</td>
</tr>
<tr>
<td>363698007</td>
</tr>
<tr>
<td>116676008</td>
</tr>
</tbody>
</table>

7.8.2.4.4.3 Manage context

*Figure 129* illustrates the steps involved in managing context information extracted from the input statement or *expression*.

The input to this process consists of the information model context, derived from the *Separate information model context* process, and the normalised *expression*, generated by the *Create Expression* step at the end of the *Normalize expression* process.

<table>
<thead>
<tr>
<th>Long normal form expression (output for candidate expressions)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Separate information model context</strong></td>
</tr>
<tr>
<td><strong>Resolve context</strong></td>
</tr>
<tr>
<td><strong>Separate expression context</strong></td>
</tr>
<tr>
<td><strong>Apply context</strong></td>
</tr>
<tr>
<td><strong>Normalized expression</strong></td>
</tr>
</tbody>
</table>

7.8.2.4.4.3.1 Separate expression context

The normalised *expression* (generated by the *Normalize expression* process) may or may not contain any context information. If it does, this context is separated from the *expression* so that it can be validated and reconciled with any information model context.

If the *focus concept* is subtype of 243796009 | situation with explicit context |
- The *expression* that represents the value of the | associated finding | or | associated procedure | attribute is passed as the context-free *expression* to the *Apply context* process;
- The focus *expression* without the | associated finding | or | associated procedure | attribute is passed to the *Resolve context*.
If the focus concept is not a subtype of 243796009 | situation with explicit context | but its refinement contains values for one or more of the following context attributes: 2470590016 | finding context |, 2470591017 | procedure context |, 2470592012 | temporal context | or 2470593019 | subject relationship context |.

- These attributes are passed to the Resolve context:
  - If the attributes present do not include a finding context or procedure context value, then an indication of the top level supertype of the focus concept is also passed with these context attributes.
  - The focus expression, with the context attributes removed, is passed as the context-free expression to the Apply context process.

If neither of the above conditions apply then
- An indication of the top level supertype of the focus concept is passed to the Resolve context process;
- The entire expression is passed as the context-free expression to the Apply context process.

7.8.2.4.3.2 Resolve context

The resolve context process takes the information model context derived from the Separate information model context process and the expression context derived from Separate expression context process and attempts to resolve them to generate a single consistent context.

The context information in the expression or information model may unequivocally indicate that:

- Finding context applies:
  - Subtypes of "finding" or "linkage concept";
  - Subtypes of | procedure | or "observable" with an associated "value" in the information model;
  - Finding context attribute value present in the expression context information.

- Procedure context applies:
  - Subtypes of | procedure | or "observable" without an associated "value" in the information model;
  - Procedure context attribute value present in the expression context information.

The appropriate default context applies unless modified
- By specific context attributes in the expression context information.
- By rules associated with particular information model context information:
  - For example, rules that in a reference file such as the MoodMap.xml (see Figure 130).

The output is one of the following
- A single context wrapper that is passed to the Apply context process.
- An indication that context is not relevant to the expression and should not be applied. This is also passed to the Apply context process allowing it to return a context-free expression.
- A report of errors arising from incompatibilities in the context information from the two sources.
<!- Suggested maps from HL7 Version 3 Mood Codes to default values for SNOMED Context attribute -->

<moodMap>
  <moodCode code="-" term="Any">
    <context id="408729009" term="finding context" defaultId="410515003" defaultTerm="known present" permitted="410514004" permittedTerm="finding context value"/>
    <context id="408730004" term="procedure context" defaultId="385658003" defaultTerm="done" permitted="288532009" permittedTerm="context values for actions"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="EVN" term="Event">
    <context id="408729009" term="finding context" defaultId="410515003" defaultTerm="known present" permitted="410514004" permittedTerm="finding context value"/>
    <context id="408730004" term="procedure context" defaultId="385644000" defaultTerm="requested" permitted="385649005 385643006" permittedTerm="being organised / to be done"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="GOL" term="Goal">
    <context id="408729009" term="finding context" defaultId="410518001" defaultTerm="goal" permitted="410518001" permittedTerm="goal"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="INT" term="Intent">
    <context id="408730004" term="procedure context" defaultId="410522006" defaultTerm="pre-starting action status" permitted="410522006" permittedTerm="pre-starting action status"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="RQO" term="Request">
    <context id="408730004" term="procedure context" defaultId="385644000" defaultTerm="requested" permitted="385644000" permittedTerm="requested"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="PRP" term="Proposal">
    <context id="408730004" term="procedure context" defaultId="385643006" defaultTerm="to be done" permitted="385649005 385643006" permittedTerm="to be done"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="PRMS" term="Promise">
    <context id="408730004" term="procedure context" defaultId="385645004" defaultTerm="accepted" permitted="385649005 385645004" permittedTerm="accepted"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>

  <moodCode code="ARQ" term="Appointment request">
    <context id="408730004" term="procedure context" defaultId="385644000" defaultTerm="requested" permitted="385644000" permittedTerm="requested"/>
    <context id="408731000" term="temporal context" defaultId="410512000" defaultTerm="current or specified" permitted="410510008" permittedTerm="temporal context value"/>
    <context id="408732007" term="subject relationship context" defaultId="410604004" defaultTerm="subject of record" permitted="125676002" permittedTerm="person - add other permitted values in future"/>
  </moodCode>
</moodMap>
7.8.2.4.3.3 Apply context

If no context wrapper is provided by the Resolve context process, the context-free expression from the Separate expression context process is returned as the fully normalised expression.

If the Resolve context process provides a context wrapper including a finding context attribute, the context-free expression from the Separate expression context process is applied to this as the value of the finding context attribute. The resulting context-dependent expression is returned as the fully normalised expression.

If the Resolve context process provides a context wrapper including a procedure context attribute, the context-free expression from the Separate expression context process is applied to this as the value of the procedure context attribute. The resulting context-dependent expression is returned as the fully normalised expression.

Figure 130: MoodMap.xml example

<table>
<thead>
<tr>
<th>moodCode</th>
<th>code</th>
<th>term</th>
<th>defaultTerm</th>
<th>permittedTerms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Apt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EVN</td>
<td>Event</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CCL</td>
<td>Goal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>INF</td>
<td>Inact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>RGP</td>
<td>Resid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PNP</td>
<td>Prop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PRS</td>
<td>Prom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>ARG</td>
<td>Appr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>APT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 131: MoodMap.xml file image
Additional steps for alternative forms

The processes described in the preceding sections generate the "long normal view". This is the most general normal form. It can be directly applied to meet key requirements related to subsumption testing. It can also be used as the source from which to derive other useful forms that are optimised for particular purposes. The following sections outline some of these.

Deriving the short normal view

The short normal form can be derived from the long normal form by the following steps.

Generate the set of normalised definitions of each primitive focus concepts

A normalised expression includes the normalised definition for concept in the original expression.

- The normalised definition includes. In the long normal form this process is extended to include the definitions of the Primitive concepts in the normalised expression.
- The values of all defining relationship are expanded and normalised by recursively following the full set of rules described in Normalisefocus concepts on page 545.

Note: Storage of pre-computed normalised forms of concept definitions simplifies this process as it removes the requirement for recursive processing of definitions at run time.

Merge the generated definition sets

This process follows exactly the steps described in Merge definitions.

Removed redundant attributes and groups

Attributes and groups shared with the merged definition are removed from the refinement. Only groups and ungrouped attributes that are identical can be removed from the refinement. If a group is not identical the parts that are similar cannot be removed.

Recursive removal of redundancy

The process described in this section is recursively applied to any nested expressions that remain after the top-level process to remove redundant attributes and groups.

Unlike the process of normalisation, this process is done breadth first at each level in the hierarchy. If long normalised forms at nested levels are shortened before checking for redundancy, the expression will not match those in the merged definition even if they are semantically identical.

Canonical representations

The idea of a canonical representation is that it generates a predictable string rendering. The missing element to deliver this in the description of the "long normal form", is a specified sort order within the collections elements in an expression. A standard sort order is not essential for general purpose use but it is very useful to enable fast matching of logically identical expressions (which might otherwise be obscured by differences in order that have no semantic relevance).

The canonical form for an expression is regarded as being the long normal form ordered according to the following sorting rules.

- The expression is rendered in the form specified by the SNOMED CT compositional grammar. For canonical representation a restricted version of the compositional grammar is used:
  - No whitespace characters may be included in the canonical form
  - No pipe characters "|" and thus no term text shall be included in the canonical form.
  - Thus the only permitted characters are:
    - Digits [0-9] - for conceptId values;
    - Plus [+] - to combine focus concepts;
    - Colon [:] - to represent the start of a refinement;
    - Equals [=] - to link an attribute name to it value;
    - Comma [,) - to separate attributes within a refinement
    - Round brackets [()] - to represent nesting;
    - Curly brackets [{}] - to represent grouping.
• The syntax determines the general order of elements within an expression as follows:
  • Focus conceptIds;
  • Attributes (expressed as name-value pairs);
  • Groups (containing attributes).

• Within a set of focus conceptIds:
  • Concept Identifiers are sorted alphabetically based on their normal string rendering (i.e. digits with no leading zeros):
    • The reason for alphabetic sorting rather than numeric sorting is that it is complex to sort attributes and groups which consist of an arbitrary number of conceptIds using numeric keys.

• Within a set of ungrouped attributes or a set of attributes within a group:
  • Attributes are sorted alphabetically based on the string concatenation of the name and value conceptIds separated by an "=" sign;
  • If a value contains nested refinements, the value is enclosed in round brackets (which may influence the sort order) and the elements of the nested expression are sorted by applying the general canonical sorting rules.

• Within a set of groups:
  • Groups are sorted by alphabetical order of the combined set of previously sorted attributes.

7.8.2.4.5 Testing subsumption and equivalence between expressions

The main reason for generating normal form expressions is to enable testing for equivalence and subsumption between different post coordinated expressions. This section describes how these processes are carried out.

The process of generating normal form for an expression also requires testing of subsumption between subsidiary elements within the expression.

7.8.2.4.5.1 Testing for equivalence

The following steps can be applied to test for equivalence between any two valid expressions.

1. Transform both expression to long normal form (see Transforming expressions to normal forms).
2. Render these normal forms according the canonical representation (see Canonical representations).
3. Perform a simple string comparison between the two long normal forms in canonical representation:
   a. If the strings are identical then the expressions being tested are equivalent;
   b. If the strings are not identical the two expressions being tested are not logically equivalent.

Note that this does not prove that the expressions are not equivalent. This limitation applies for the following reasons:

• One or more of the concepts referenced by the original expressions may be primitive (i.e. not fully defined) and this may obscure the equivalence.

• Two different expressions may include an alternative “sufficient set” of attributes that imply the same meaning (see Nature of the definition).

7.8.2.4.5.2 Testing expression subsumption

The following steps can be applied to test for subsumption of any candidate expression by a predicate expression.

31 This issue will gradually diminish in significance as more concepts are fully defined through addition of new defining relationships.
1. Transform the predicate expression to short normal form\(^{32}\) (see Deriving the short normal view on page 556):
   - The resulting "predicate short normal form expression" is referred in subsequent steps as the normalised-predicate.

2. Transform the candidate expression to long normal form (see Transforming expressions to normal forms):
   - The resulting "candidate long normal form expression" is referred in subsequent steps as the normalised-candidate.

3. Test for subsumption between the normalised-predicate and the normalised-candidate by applying the tests described in Testing subsumption between two normal form expressions on page 558:
   - The predicate expression subsumes the candidate expression if the normalised-predicate subsumes the normalised-candidate.

7.8.2.4.5.2.1 Testing subsumption between two normal form expressions

The following steps are applied to test if a normalised-predicate subsumes a normalised-candidate. This assumes that these normal form expressions have been generated as outlined in Transforming expressions to normal forms.

1. Test that each focus concept referenced in the normalised-predicate subsumes at least one focus concept in the normalised-candidate:
   - If not, the normalised-predicate does not subsume the normalised-candidate. No further testing is required:
     - Exit with result false.
   - The approach to testing concept subsumption is described in section Testing concept subsumption on page 560.

2. Test that each attribute group in the normalised-predicate subsumes at least one attribute group in the normalised-candidate:
   - If not, the normalised-predicate does not subsume the normalised-candidate. No further testing is required:
     - Exit with result false.
   - The approach to testing attribute group subsumption is described in Testing subsumption between two attribute groups on page 558.

3. Test that each ungrouped attribute in the normalised-predicate subsumes at least one attribute (either grouped or ungrouped) in the normalised-candidate:
   - If not, the normalised-predicate does not subsume the normalised-candidate:
     - Exit with result false.
   - The approach to testing attribute subsumption is described in Testing attribute subsumption on page 560.

4. If all these tests succeed, the normalised-predicate subsumes the normalised-candidate:
   - Exit with result true.

7.8.2.4.5.2.2 Testing subsumption between two attribute groups

The following steps test if a predicate -attribute group subsumes candidate -attribute group.

1. Check the predicate -attribute group for the presence of the attribute: 408729009 | finding context |

\(^{32}\) The predicate long normal form can be used instead of the predicate short normal form. However, the short form is preferred as it reduces the number of steps required in testing each candidate expression.
• If the group does not contain this attribute, apply the normal attribute group tests specified in Testing a normal attribute group on page 559.

2. If the predicate -attribute group contains the 408729009 | finding context | attribute, check whether its value is one of the following: 410516002 | known absent | or 410594000 | definitely not present |

• If the attribute exists and has one of these values, apply the tests for a context attribute group with absent finding, as specified in Testing a context attribute group with absent finding on page 559;

• If the attribute exists and has any other value, apply the tests for a normal attribute group, as specified in Testing a normal attribute group on page 559.

7.8.2.4.5.2.2.1 Testing a normal attribute group

The following step tests most attribute groups. However, a modified approach (see Testing a context attribute group with absent finding on page 559) is required in the case of attribute groups that indicate the absence of a finding.

1. Test that each attribute in the predicate -attribute group subsumes at least one attribute in the candidate -attribute group:

• If not, the predicate -attribute group does not subsume the candidate -attribute group:

• Exit with result false.

• The approach to testing attribute subsumption is described in Testing attribute subsumption on page 560

2. If all attributes in the group pass this test, the predicate -attribute group subsumes the candidate -attribute group:

• Exit with result true.

7.8.2.4.5.2.2.2 Testing a context attribute group with absent finding

The following steps test most attribute groups that indicate the absence of a finding. This approach differs from the general tests applicable to other attribute groups because of the way in which assertions of absence affect the direction of subsumption. This is discussed in detail in Recording and retrieving absent findings.

1. Attempt to match each attribute in the predicate -attribute group with an Attribute which has the same name in the candidate -attribute group:

• If any attribute in the predicate -attribute group is not matched by an Attribute with same name in the candidate -attribute group, the predicate -attribute group does not subsume the candidate -attribute group:

• Exit with result false.

2. For each of the matched attributes identified in the previous step, compare the value of the attribute in the predicate -attribute group with the value of the same attribute in the candidate -attribute group:

• If the attribute name is 408729009 | finding context | or 408731000 | temporal context |, the candidate-value must be equivalent to or subsumed by the predicate-value.

• However, if the attribute name is 246090004 | associated finding | or 408732007 | subject relationship context |, the direction of the test is inverted. In these cases, the predicate-value must be equivalent to or subsumed by the candidate-value.

• If any of these tests fail, the predicate -attribute group does not subsume the candidate -attribute group:

• Exit with result false.

• Attribute values are expressions and are tested in the same way as any other expressions (see Testing subsumption between two normal form expressions):

• Expression subsumption testing is recursive where expressions include nested qualifiers.
3. If all the tests above are successful, the *predicate* -attribute group subsumes the *candidate* -attribute group:
   - Exit with result *true*.

7.8.2.4.5.2.3 Testing attribute subsumption

The following steps test if a *predicate* -attribute subsumes a *candidate* -attribute.

1. Test that the candidate attribute name is either the same as or subsumed by the predicate attribute name:
   - If not, the *predicate* -attribute does not subsume the *candidate* -attribute:
     - Exit with result *false*.
   - The approach to testing concept subsumption is described in *Testing concept subsumption*.

2. Test that the *candidate* -attribute value is equivalent to or subsumed by the *predicate* -attribute value:
   - If not, the *predicate* -attribute does not subsume the *candidate* -attribute:
     - Exit with result *false*.
   - *Attribute values are expressions* and are tested in the same way as any other expression (see *Testing subsumption between two normal form expressions*):
     - *Expression subsumption testing is recursive where expressions include nested qualifiers.*

3. If both the above tests are successful, the *predicate* -attribute subsumes the *candidate* -attribute:
   - Exit with result *true*.

7.8.2.4.5.2.4 Testing concept subsumption

The following steps test if a *predicate* -concept subsumes a *candidate* -concept.

1. Test if candidate -concept is an inactive concept:
   - Check is the candidate-concept is in one of the *Historical Association Reference Sets*. Some *Historical Association Reference Sets* point to active concept with have replaced duplicate, erroneous or ambiguous concepts.
     - This can allow a replacement *active concept* to be used in subsequent steps

2. Test if the *candidate* -concept is identical to the *predicate* -concept:
   - If *candidate* -concept.id == *predicate* -concept.id the concepts are identical:
     - Exit with result *true* (accept equivalent).

3. Test if the *predicate* -concept is one of the supertype ancestors of the *candidate* -concept:
   - This is true if a sequence of | is a | relationships leads from the *candidate* -concept (sourceld) to the *predicate* -concept (destinationId):
     - Exit returning the result of this test.
   - Various approaches to optimisation of this test are described in *Optimizing concept subsumption testing*. The recommended approach is to use a transitive closure table (see *Transitive Closure Implementation*).

---

33 Active concepts that are related to ambiguous candidate -concepts should only be tested after deciding whether the prime objective of retrieval is “completeness” (in which case include these possible related concepts) or “precision” in which case they should be excluded unless the ambiguity can be resolved by the term selected with the original concept.
Optimisation of normalisation and expression subsumption testing

The steps in the normal transformation and subsumption testing processes are not particularly onerous. However, queries require thousands or millions of such tests to be carried out. It is therefore likely that most practical implementations will require some type of optimisation to support tests for subsumption between expressions.

The method described in this section is one approach to optimisation. The central idea is the use of a repository to store expressions and relationships between expressions.

The advantages of this include the following:

- All transform computations can be done off-line rather than at run-time;
- Less transforms are done as each distinct candidate expression need only be transformed once when created and once more each time a new release alters the definitions on which it is based:
  - Other approaches either require:
    - real-time transformation each time a candidate expression is considered for retrieval;
    - storage of normal forms in each record entry and updating of each normal form instance whenever a new release affects the definitions on which it is based.

Neither of these approaches appears to be scalable over time, as record volumes increase. In contrast the proposed optimisation is not affected by the total number or records but only by the total number of distinct expressions encountered.

- Additional optimisation is possible by pre-classifying the repository so that individual queries can test an expression with a single join to a table representing the transitive closure of all used expressions.

The approach described in the following section is only one way of implementing the central idea of optimisation using an expression repository. There several ways to harness the same general technique and some of these may be better suited to particular requirements or technical environments.

7.8.2.4.6.1 Expression repository design

The primary requirements for an expression repository are:

- Allocation of a fixed length, unique Identifier for every expression used in an operational environment:
  - The size of an operational environment may range from an individual application at a particular site to a large multi-site organisation using multiple applications that use the same expression repository.
  - The easiest way to deliver unique Identifiers within this range of organisational scales is the use of a UUID (also referred to a GUID). The UUID /GUID allocation algorithm provides an industry standard approach to allocation of universally unique 128-bit Identifiers and is readily available in all widely used operating systems.
  - Linking every close-to-user expression with its long normal form:
    - It is necessary to update this link each time a new release of SNOMED CT changes an underlying relationship that may affect the normal form.
  - The expressions themselves need to be searchable:
    - The canonical version of the SNOMED CT compositional grammar is recommended for this purpose because it has a minimum of syntactic noise and a specified sort order for the elements within the expression.
    - Despite these advantages some normal form expressions can be quite long. Currently the longest normal forms seen are up to 300 characters long. For a degree of future proofing it is suggested that the longest indexable variable length character string should be used (e.g. in MS SQL Server a length of up to 900 characters).

Two possible designs that meet this goal are suggested in next two sections.
• The first option uses two tables - one to identify expressions and the other to link them to indicate the results of transformation (see Dual table expression repository).

• The second approach is less flexible and in its current form it lacks many of the features of the first option. It is included in this guide because it follows an original suggested design and indicates an alternative for consideration and discussion. (see Single table expression repository).

Whichever of these designs is used the general steps in using the tables is similar (see Using the expressions repository)

7.8.2.4.6.1.1 Dual table expression repository

A dual table design is more flexible and potentially more compact than a single table expression repository. The compactness is achieved because each distinct normal form only occurs once in one row of the table. The flexibility results from the ability to make multiple links between expressions to specify the results of different transforms without repeating the expression.

Each discrete expression (whether close-to-user or one of the normal forms) is allocated a unique ExpressionId when it is first used or generated. From this point on, this ExpressionId is immutably linked to the expression and the expression must not be altered in anyway.

The ExpressionLink table represents the linkage between an expression and its normal forms. ExpressionLinks can be updated as necessary (i.e. when a new release is received) without any effect on the existing content of the Expression table. However, an additional row will be added to the expression table whenever a transform results in a new expression (i.e. any expression that is not in the Expression table).
Table 274: Suggested structure for the Expression table in a dual table expression repository

Each row in the Expression table represents and identifies an expression. All expressions used are identified in this way (i.e. close-to-user and normal forms) and the links between an expression and a transformed version of that expression are specified by the ExpressionLink table.

<table>
<thead>
<tr>
<th>Primary Key</th>
<th>Field Type</th>
<th>Permitted characters</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExpressionId</td>
<td>GUID</td>
<td>binary-or - string version</td>
<td>16/36</td>
<td>Unique Identifier for this expression.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Fields</th>
<th>Field Type</th>
<th>Permitted characters</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expression</td>
<td>String</td>
<td>0 to 9 and { } ( ) - , + :</td>
<td>6-900</td>
<td>Canonical rendering of an expression in SNOMED CT compositional grammar</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Indexed</em></td>
</tr>
<tr>
<td>DateAdded</td>
<td>IsoDateTime</td>
<td>binary-or - string version</td>
<td>8/20</td>
<td>Date time of addition of this Expression to the expressions table. YYYYMMDDhhmmss+ZZ.zz</td>
</tr>
</tbody>
</table>
Table 275: Suggested structure for the ExpressionLink table in a dual table expression repository

Each row in the ExpressionLink table links a source Expression with the result of transforming that expression. The DateIn and DateOut columns allow active and inactive links to be stored in the same table - easing historical review of changes. The primary key ExpressionLinkId allows multiple rows to link the same pair of expressions where a link is valid in one release, not valid in the next and restore in a subsequent release.

<table>
<thead>
<tr>
<th>Primary Key</th>
<th>Field Type</th>
<th>Permitted characters</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExpressionLinkId</td>
<td>GUID</td>
<td>binary-or string version</td>
<td>16/36</td>
<td>Unique Identifier for this expression link</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Fields</th>
<th>Field Type</th>
<th>Permitted characters</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SourceExpressionId</td>
<td>GUID</td>
<td>binary-or string version</td>
<td>16/36</td>
<td>Foreign key link to the Expression table row for the source expression which is linked to a transform by this link. <em>Indexed</em></td>
</tr>
<tr>
<td>ResultExpressionId</td>
<td>GUID</td>
<td>binary-or string version</td>
<td>16/36</td>
<td>Foreign key link to the Expression table row for an expression representing the result of the transform applied to the source expression <em>Indexed</em></td>
</tr>
<tr>
<td>TransformType</td>
<td>Enum</td>
<td>digits [0-9]</td>
<td>2</td>
<td>An enumerated value representing the nature of the transform between the source and result expressions. Values might include: 0=Single concept expression Long normal form 1=Other expression Long normal form 2=Long normal form Short normal form A direct transform for each expression to short normal form could be added buy is not essential this can be achieved by traversing a type 0 or 1 link followed by a type 2 link.</td>
</tr>
<tr>
<td>Data Fields</td>
<td>Description</td>
<td>Length</td>
<td>Permitted characters</td>
<td>Field Type</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>--------</td>
<td>----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>DateIn</td>
<td>Date time of addition of this CtuExpression to the expressions table.</td>
<td>YYYYMMDDhhmms+ZZ.zz</td>
<td>binary-or-string version</td>
<td>IsoDateTime</td>
</tr>
<tr>
<td>DateOut</td>
<td>Date time at which this ExpressionLink was rendered obsolete by replacement.</td>
<td>YYYYMMDDhhmms+ZZ.zz</td>
<td>binary-or-string version</td>
<td>IsoDateTime</td>
</tr>
</tbody>
</table>
7.8.2.4.6.1.2 Single table expression repository

The single table approach provides direct mapping between a close to user expression and a normal form. This was the original suggested design for an expressions table. However, a dual table approach provides a more efficient and more flexible solution (see Dual table expression repository).
Table 276: Suggested structure for a single table expression repository

CtuExpression Table

Each row in the Expression table represents a close-to-user form expression and it relationship to a normal form expression.

<table>
<thead>
<tr>
<th>Primary Key</th>
<th>Field Type</th>
<th>Permitted characters</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExpressionId</td>
<td>GUID</td>
<td>0 to 9 and A to F and {} -</td>
<td>16/38</td>
<td>Unique Identifier for this close-to-user expression.</td>
</tr>
</tbody>
</table>

Data Key

<table>
<thead>
<tr>
<th>Data Key</th>
<th>Field Type</th>
<th>Permitted characters</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CtuExpression</td>
<td>String</td>
<td>0 to 9 and {} ( ) - , + = :</td>
<td>6 - 300</td>
<td>Canonical rendering of close to user expression in SNOMED CT compositional grammar</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Indexed</em></td>
</tr>
<tr>
<td>LongNormalExpression</td>
<td>String</td>
<td>0 to 9 and {} ( ) - , + = :</td>
<td>6 - 900</td>
<td>Canonical rendering of long normal form expression in SNOMED CT compositional grammar</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Indexed</em></td>
</tr>
<tr>
<td>DateUpdated</td>
<td>IsoDateTime</td>
<td>0 to 9</td>
<td>20</td>
<td>Date time of last update to the LongNormalExpression for this CtuExpression.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>YYYYMMDDHhmms+ZZ.zz</td>
</tr>
<tr>
<td>DateAdded</td>
<td>IsoDateTime</td>
<td>0 to 9</td>
<td>20</td>
<td>Date time of addition of this CtuExpression to the expressions table.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>YYYYMMDDHhmms+ZZ.zz</td>
</tr>
</tbody>
</table>
7.8.2.4.6.2 Using the expressions repository

Whichever approach is taken to the design of the repository the way in which it is used is similar.

7.8.2.4.6.2.1 Run-time data entry and inbound communications

Each time an expression is recorded (either directly or in an inbound communication) the expression is looked up in the repository. The expression is rendered using the canonical version of the SNOMED CT compositional grammar and an expression matching this string is looked for in the repository.

If the expression is not found a new row is added to the expression repository.

Whether a row is found or added the unique Identifier of the expression is added to the record entry or other resource in which the information encoded by the expression is to be stored. Depending on authentication and other requirements, the original form of the expression may also be stored.

This step is often referred to a “just-in-time precoordination” because a precoordinated Identifier for the postcoordinated expression is generated at the time it is required. It is also possible to prime the repository with a range of expressions that are anticipated (e.g. because they are generated by a particular set of forms or protocols).

7.8.2.4.6.2.2 Run-time display or outbound communications

Although an expression repository may be shared across a large multi-site organisation, there are advantages in requiring communication to adhere to standards that are not limited to bounds of that organisation and which are not dependent on real-time communication with the repository. Therefore, when there is a requirement to display or communicate the information represented by an expression Identifier, the expression should be looked up in the repository and added to a communication in its original form.

7.8.2.4.6.2.3 Support for normal form transformation of new expressions

The transforms described in this guide are applied to all new expressions in the repository. Where a transforms results in a new expression, this expression is added to the repository. The appropriate reference between the original expression and normal form expression is created, in a manner determined by the repository design.

7.8.2.4.6.2.4 Support for normal form transformation after updates to SNOMED CT definitions

After a SNOMED CT update, the repository is refreshed to check for consequent changes in the normal forms for existing expression. Where changes are required the appropriate rows in the repository are added or updated in accordance with the repository design.

7.8.2.4.6.2.5 Supporting retrieval with an expression repository - basic

Retrieval requests can be dealt with by using the repository to locate the appropriate normal forms for the predicate expression and for candidate expressions. Instead of requiring processing to transform expressions in real-time a simple SQL query can immediately return the appropriate expression. The general process of process testing subsumption between expression is then applied as documented in this guide (see Testing subsumption and equivalence between expressions).

7.8.2.4.6.2.6 Supporting retrieval with an expression repository - advanced

Further optimisation is possible if the expressions in the repository are classified to generate an extended transitive closure table. This process is similar in effect to testing for subsumption between every pair of expressions in the repository and recording the results of each successful test as a row in a table that identifies the relationship between the subsuming and subsumed expression. This process may appear to be unscalable because it requires many millions of tests to be carried out. However, fortunately algorithms are available that can optimise this process and classify hundreds of thousands of concepts in a little over an hour on what would today be considered a fairly modest system.

If this approach is followed, any predicate expression can be tested against any candidate expression by a simple SQL query using this extended transitive closure table. The result of this is that testing subsumption of an expression will perform practically as fast as testing the subsumption between two precoordinated concepts.
7.8.2.4.6.2.7 Is storing an expression the same as creating a new concept?

In one sense adding an expression to a repository and giving it an Identifier is the same as creating a new concept. However, there are some subtle but highly significant differences between storing, identifying and reusing an expression in the way suggested in the guide and a SNOMED CT concept. These are summarised in Differences between concepts and stored expressions.

Table 277: Differences between concepts and stored expressions

<table>
<thead>
<tr>
<th>SNOMED CT released concept</th>
<th>Stored expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>The defining relationships of a SNOMED CT concept are intended to represent the meaning of words or phrases as they are used in clinical practise.</td>
<td>An expression is the collection of references to a set of SNOMED CT concepts.</td>
</tr>
<tr>
<td>The meaning of a SNOMED CT concept is represented by the Fully Specified Name (and sometimes by an associated textual definition).</td>
<td>An expression is not associated with a specific text string. It may be rendered in different human readable forms but its only source of meaning is the meaning of the concepts it references.</td>
</tr>
<tr>
<td>Because a concept definition attempts to express the human understood meaning of a word or phrase the logical definition expressed by its defining relationship may not be sufficient to fully define the concept. In these cases the concept definition is marked as &quot;primitive&quot;.</td>
<td>Because an expression has no specific term or source of meaning other than the focus concept and Attribute it is inherently &quot;fully defined&quot; in that those Attributes fully define what the expression may be used to represent.</td>
</tr>
<tr>
<td>A SNOMED CT Concept can be bound to various terms that are deemed to be synonyms in a given language. The SNOMED CT design provides a framework for managing these bindings, correcting errors, supporting translations and tracking the history of changes.</td>
<td>It may be tempting to associate particular words or phrases with an expression. This will inevitably occur in instances in individual record entries. However, terms should not be bound to expressions in a way that suggests a formal persisting association between that term and the class represented by the expression. If such a binding is required a SNOMED CT concept should be requested (or created in an extension) to provide a proper framework for managing that binding.</td>
</tr>
</tbody>
</table>

7.8.2.4.7 Retrieving absent findings

This part of the guide is based on a white paper produced in May 2006 to consider the impact of "negatives" on transformation, normalisation and subtype testing rules. The outcome of this was revision of the rules on subsumption testing in relation to context attribute groups that include finding context values indicating that a finding is known to be absent.

7.8.2.4.7.1 Rationale

The wider issue of different types of negation cannot be completely resolved in a short space of time - as has been demonstrated during numerous previous discussions. However, there are some aspects of current advice on computation of subsumption that appear to be misleading in relation to concepts that express the absence of a finding.

For example, current subtype testing rules on the following expression:

373572006 | clinical finding absent | :
246090004 | associated finding | = ( 125605004 | fracture of bone | :
363698007 | finding site | = 71341001 | bone structure of femur | )

normalises as follows
The result of applying "normal" subsumption testing rules is that | no fracture of femur | is subsumed by | no fracture of bone |. Superficially this may seem reasonable, but it will incorrectly cause the inference that a person with a record of | no fracture of femur | has | no fracture of a bone |. This is true if | no fracture of a bone | meant one bone that it not fractured, but the generally understood meaning would be that the patient had no fractured bones.

Thus the objective was to revise the transformation and/or subtype testing rules to appropriately handle expressions that represent absent findings.

7.8.2.4.7.2 Overview

The approach specified in this guide deals with the computational issue of subtype testing based in the current concept model, classifier logic and distribution format of SNOMED CT. The approach has been tested and produces reasonable results with current data. It also works appropriate with combined presence and absence finding (e.g. "head injury without skull fracture") provided these are modelled using separate context attribute groups.

The positive statement in the previous paragraph must be tempered by the knowledge that a logical technical approach is only a part of the solution. Human factors are an important issue when considering the proper processing of concepts of absence and other forms of negation. Therefore, it is also necessary to consider what people may mean when they explicitly state the "absence of a finding"; and what other people may intend when they query records to determine the presence or absence of a finding.

The technical approach suggested for subsumption testing expressions that involve absence of a finding are valuable only if applied appropriately. Human interpretation may be required to determine the clinical relevance of the results of absent subtype tests for a particular purpose.

7.8.2.4.7.3 Testing subsumption of absence of a finding
7.8.2.4.7.3.1 Initial assumptions

The general rules for computation of subsumption of expressions and transformation to normal forms are stated in detail in the SNOMED CT document on transformation to normal forms. They can be summarised as follows:

When two expressions are tested for subsumption, tests are performed recursively on the following elements within the normal form of those expressions:

- Groups of attribute value pairs;
- Attribute value pairs;
- Nested expressions use to represent values within an attribute value pair.

The normal form of an expression is derived by a set of rules which retain the full semantic meaning of the original expression while transformation it to a form in which:

- Every referenced focus concept is a primitive concept
- Every attribute value is a normalised expression
- Grouping and nesting of Attributes is aligned with the concept model
- Default context or context derived from the information model is made explicit using SNOMED CT context Attributes
7.8.2.4.7.3.2 Identifying expressions that include absence

The normal form of any expression that represents absence of finding includes the following standard context Attributes:

243796009 | situation with explicit context | :
408729009 | finding context | = 410516002 | known absent | (or a subtype)
,408731000 | temporal context | = <temporal context value>
,408732007 | subject relationship context | = <subject Relationship context value>
,246090004 | associated finding | = <a clinical finding or event>

When the value of finding context is known absent (or one of its subtypes) then it may be appropriate to apply subtype testing rules based on absence. However, as discussed in recording and retrieving absent findings, the way in which rules are applied depends on the intended results of the query and rationale behind recording a negative finding.

7.8.2.4.7.3.3 Testing groups rather than expressions

The relevant information in an expression can be regarded as a group of attributes as follows:

{ 408729009 | finding context | = 410515003 | known present | (or a subtype)
, 408731000 | temporal context | = <temporal context value>
, 408732007 | subject relationship context | =
, 246090004 | associated finding | = }

Considering absence at the group level, rather than at the expression level, allows account to be taken of expressions that refer to presence of one finding and absence of another.

The following style of expression represents the presence of "first clinical finding" and the absence of "second clinical finding".

243796009 | situation with explicit context | :
{ 408729009 | finding context | = 410516002 | known absent | (or a subtype)
, 408731000 | temporal context | = <temporal context value>
, 408732007 | subject relationship context | =
, 246090004 | associated finding | = }

{ 408729009 | finding context | = 410516002 | known absent | (or a subtype)
, 408731000 | temporal context | = <temporal context value>
, 408732007 | subject relationship context | =
, 246090004 | associated finding | = }

In this case, the first group is tested according to the general subsumption testing rules and the approach to absence may be appropriate to the second group (i.e. the group that includes finding context | = | known absent |).

The overall expression, containing both these groups, is then tested in the general way according to whether the two groups separately pass the relevant test. The general subsumption testing rules allow groups not present in the predicate expression to be present in the candidate expression. Therefore both of the following predicate expressions subsume the candidate expression above irrespective of the special rules for handling absence.

Predicate 1 - "first clinical finding present"

243796009 | situation with explicit context | :
{ 408729009 | finding context | = 410515003 | known present | (or a subtype)
, 408731000 | temporal context | = <temporal context value>
, 408732007 | subject relationship context | =

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7.8.2.4.7.3.4 Testing | associated finding | in groups containing | known absent |

If a group contains | finding context | = | known absent | then the test applied to the value of the | associated finding | Attribute is changed.

The general purpose test for the value of an Attribute is:

- "is the candidate value identical to or a subtype of the predicate value".

The alternative test when the group contains | known absent | is:

- "is the predicate value identical to or a subtype of the candidate value".

7.8.2.4.7.3.5 Testing | subject relationship context | in groups containing | known absent |

If a group contains | finding context | = | known absent | then the test applied to the value of the 408732007 | subject relationship context | Attribute should also be changed to the alternative form.

- "is the predicate value identical to or a subtype of the candidate value".

Thus:

- "family history of heart disease in father | implies | FH: Cardiac disorder |; but;
- "no family history of heart disease" implies "no family history of heart disease in father".

7.8.2.4.7.3.6 Testing | temporal context | in groups containing | known absent |

If a group contains | finding context | = | known absent | then the test applied to the value of the | temporal context | attribute needs to be carefully considered depending on the intended result of the query.

In some cases it may also be changed to the alternative form.

- "is the predicate value identical to or a subtype of the candidate value".

Thus:

- "currently has asthma" implies "has, or at some time in past had, asthma"; but;
- "did not have headache recently" does not imply "did not have headache in the past".

However, since the value "all times past" is specified for expressing concepts like | never had a headache | the standard subsumption test rules may work in some cases.

Since the time aspect in the record is relative to the time of recording while the intended result of a query may be relative to a specified time (or the time of the query) the use of temporal context in queries requires careful consideration on a query by query basis.

7.8.2.4.7.3.7 Differences between subject Relationship and temporal context

The difference between the handling of "408732007 | subject relationship context |" and | temporal context | noted in Testing [subject relationship context] in groups containing [known absent] and Testing [temporal context] in groups containing [known absent] may result from a significant difference in value hierarchies.

Thus "no family history of asthma" literally means something like:

"As far as is known, at all times in the past, the disorder asthma was absent from, all members of the subjects family "

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The temporal context value hierarchy includes the value "all times past" to capture one part of this. However, for the "all Members of the subject's family" we use the same concept as is used for asserting "at least one Member of the family".

An argument can be made for aligning the approach in both these hierarchies in one of two ways:

1. Removing the value "all times past" from temporal context and using "current or past" in its place. Then the subtype testing of temporal context would invert in the same way as for the other Attributes (i.e. in absence mode the "current or past" would imply all other temporal context ... aka "all times past").

2. Adding "all Members of family" to the subject relationship value hierarchy and carefully applying this in all negation expressions. In this case, the alternative subtype testing would only apply to associated finding.

While approach (b) may appear more rational it does seem to have two disadvantages:

- It requires more disciplined use in modeling and in postcoordination
- Several new "all" values would be needed - "all Members of paternal family", "all male Members of family", "all known contacts", etc. to allow negatives to be expressed clearly.

7.8.2.4.7.3.8 Impact of nesting context expressions

Currently, the concept model does not allow a subtype of Situation with explicit context to be the value of a defining Relationship. However, some potential use cases have been advanced for allowing a Finding with explicit context to be the value of an attribute. If this is permitted then inclusion of known absent in such a nested expression would create additional complexity when trying to resolve queries.

Applying the current testing rules at appropriate nested levels may have the desired result. However, there would be an increased risk of double-negatives and similar logical problems. Therefore, until there are real cases to test, the possibility of new exceptions arising cannot be ruled out.

7.8.2.4.7.4 Human factors and testing absence

The reasons for recording information about absent findings and the rationale for attempting to retrieve information about absent findings often differ from and interact with the strict logical interpretation of negation. Specific aspect of this general point are illustrated by the following subsections.

7.8.2.4.7.4.1 Subtype classification of absent findings

When considering subsumption testing as part of the process of classifying the concepts in SNOMED CT the underlying assumptions is that the comparison process is potentially symmetrical. Thus any two concepts can be compared to ask the following questions:

- Are A and B identical? ... if not then
- Is A a subtype of B? ... if not then
- Is B a subtype of A?

If not then we might possibly be interested in the semantic proximity of the concepts for example ...

- What supertypes do A and B share?
- Are there any concepts that are subsumed by both A and B.

In this relatively abstract environment it is possible to discuss ideas about known absent or not done. These ideas may seem theoretically sound while being less readily applicable in practical clinical applications. In some cases the practical view may be more complex than the abstract view but in the case of "absence" it seems possible that considering real use cases may in some ways simplify or at least assist in prioritisation.

7.8.2.4.7.4.2 Querying records for absence findings

Subsumption testing in a clinical application is typically concerned with testing instances of expressions in clinical records ("candidate expressions") against sets of criteria some of which are represented as expressions ("predicate expressions").

- A predicate is an expression against which other expressions are tested. Predicate expression may be constructed for specific queries or may be developed as reusable part of clinical protocols, decision
support rules or report specifications. In these cases, the author of a predicate is someone trying to find out something by querying a record or set of records.

- The candidate is an expression that is tested to see if it is subsumed by the predicate. Candidate expressions may be constructed directly by the author of a clinical statement (i.e. an instance of an entry in the record) or by an application designer determining the way in which particular user decisions are recorded. Thus the direct or indirect author of the candidate is typically someone wishing to record (or enable the recording of) a finding or procedure in a record. Although the candidate expression is a crucial part of subsumption testing its reason for existing is not determined by the requirements of a specific query but rather by what the user wishes to record.

The more abstract subsumption testing for classification described in the previous section is a prerequisite for effective subsumption testing in clinical applications. However, the differences between the motivations of those constructing predicate and candidate expressions mean that subsumption testing in clinical applications is rarely a symmetrical comparison. The typical test is "does this candidate satisfy the criteria?" or in some cases "could this candidate possibly satisfy the criteria?"

When considering absence or other kinds of negation the difference between the perception of the author of an instance of clinical information and the view of the person constructing a query may be even more significant. Thus technical rules for testing subsumption of known absent finding are only one part of the picture.

To avoid misunderstanding and consequent errors it is worth considering two general questions:

- What are the possible motivations for recording a known absent finding?
- What are the possible motivations for specifying retrieval queries for absent findings?

The next two sections identify several different answers to these questions.

7.8.2.4.7.4.3 Motivations for recording a known absent finding?

There thousands of possible findings that might be made at every encounter (and theoretically every second). The vast majority of absent finding are not recorded but there are clearly some good reasons for explicitly recording the absence of some findings. These might include:

1. To record that the author asked a question and got a negative response.

   **Example:**
   
   "Family history - No family history of asthma".
   
   Implied meaning - "I asked the patient if anyone in their family has or had asthma and they said 'no'".

2. To record that the author examined/investigated and did not find this.

   **Example:**
   
   "No heart murmur".
   
   Implied meaning - "I listened for a heart murmur and did not hear one".

3. To record a possible conclusion that the author considered and rejected.

   **Example:**
   
   "No meningitis" (as part of an assessment of a patient with a fever and headache).
   
   Implied meaning - "I considered the possibility of meningitis and rejected it".

4. To refute a statement made by someone else.

   **Example:**
   
   "Not appendicitis" (in a record that contains an earlier assertion of "diagnosis appendicitis").
   
   Implied meaning - "The admitting doctor's diagnosis of appendicitis seems to be incorrect".

5. To indicate a change in an earlier assessment.
Example:

| Carcinoma of bronchus excluded | (as part of record in which the same author previously thought this a likely diagnosis).

Implied meaning - "I thought they might have Ca bronchus but following investigations I have now rejected this diagnosis".

6. To note the resolution of finding that was previously present.

Example:

"No abdominal pain" (in a record which has a previous finding of "abdominal pain present").

Implied meaning - "The abdominal pain present on admission has now resolved".

7. To indicated that a finding that is commonly present in associated with another finding is not present in this case.

Example:

"No loss of consciousness" (in the record of patient who has had a head injury).

Implied meaning - "They did not lose consciousness following an injury which potentially could have caused this".

In (1), (2) and (3) the dominant motive may be to assert what was done or considered. However, recording absent findings may also be a part of the process the author followed to organise her thoughts.

Both (4) and (5) record difference in view related to some previous assertion. Where this is the intention a strong case can be made for linking the statements in the record structure. However, this is a possible motivation even if such links are supported by the system or have not been added to this instance.

In the case of (6) the use of absent indicates a change in condition of the patient rather than an update of the diagnosis or interpretation by the clinician.

In case (7) an absent finding is recorded to refine the nature of a specific condition.

There is considerable overlap between these reasons motivations for recording absence. However, the overall motivation for recording an absent finding may or may not be aligned with the rationale for requesting retrieval of negative findings. This mismatch is likely to lead to lead to anomalous results if the assumptions based only on a logical interpretation of negation.

7.8.2.4.7.4.4 Motivations for specifying retrieval of "known absent" finding?

When querying for absence of a finding the most likely motivation is to establish the absence of a finding. In the absence of evidence to the contrary the normal assumption is that an abnormal finding is absent. Furthermore, in most cases a point in time assertion of absence does not imply the finding was never true, nor that could not be true at a future point in time. Thus in most cases, a query for absence is more concerned with checking that there is no statement indicating the presence of the finding rather that searching for a statement of presence.

There are exceptions to this:

• If the abnormal finding is usually found in associated with a confirmed finding:
  • E.g. "absence of chest pain" in a patient with a confirmed "myocardial infarction").

• If the abnormal finding is obscure and may easily have been overlooked:
  • E.g. "Koplik's spots".

• If an assertion of presence of a finding was made by an informer of unknown reliability:
  • E.g. Bystander asserts that patient had a "heart attack" but clinical assessment excludes this.

If these exceptions apply the presence of a statement of an absent finding may be of interest. However, this depends of specific thinking around the question being posed so that the query criteria achieve the
desired result. It is not enough to simply search for a specific absence and its subtypes. The assumptions about presence or absence of a finding must be considered.

Example: determine the number of road accident victims who have been admitted to hospital but have no fractured bones. In practical terms the best approach would just be to exclude those with known presence of fracture. The assumption is that, unless a fracture is mentioned, they are not known to have a fracture.

Another possible motivation for looking for absence findings is to monitor or audit the delivery of care and check that appropriate questions have been asked, tests done, possibilities considered, etc. In these cases, the query needs to search for both presence and absence ... or possibly for a procedure code representing the appropriate examination or investigation.

Example: Were all patients admitted for routine surgery asked if they had any allergies.

7.8.2.4.7.5 Conclusions on absent findings

There are rational reasons for wishing to record and retrieve information about absent findings. However, there is not a direct one-to-one relationship between the motivations for recording absence and the motivations for retrieval.

The suggested technical advice on subsumption testing of known absent findings addresses the logical question of subsumption, but this is only one part of the picture. The meaning implied by recording a known absent finding needs to be considered in the context of the intention of a query. When this is understood the alternative subsumption test can be applied appropriately to support complete and accurate retrieval.

7.8.2.4.7.6 Procedures | not done |

The use of the procedure context value | not done | (and subtypes) has similarities to the finding context value | known absent |. The same alternative rules for subsumption computation could be applied to associated procedure value. Similar human factor considerations are also likely to apply.

The range of procedure context values is wider and covers decision, request and intent as well as the simple observation that something was not done. Thus variants such as | not to be done | and | not requested | also need to be considered.

7.8.2.5 Terminology query languages

A terminology query language goes beyond compositional grammar: it supports additional criteria used to filter content that is not necessarily part of a concept definition.

Example use cases:

1. The department responsible for clinical research needs to create queries that will select a portion of the terminology (i.e. "all infectious diseases caused by gram negative bacteria") that are meaningful for some specific purpose.

2. A group planning a translation project needs to define queries that will extract subject-specific refsets to be forwarded to specialists groups.

Example query: All the subtypes of "Clinical finding" that include a finding site descendant of "thorax" and the FSN matches "pain"

The Query Specification Reference Set can be used to store string forms of terminology queries, associated with a reference set; this enables the generation of its members.

An standard specification for a Query Language for SNOMED CT is not yet defined. Many terminology management tools have developed their own query languages and representations. The "Refset Specifications" in the IHTSDO workbench is a representative example.

Expression languages or concept definition representation grammars can be used as query languages, using the techniques described in Concept definition queries and Expression retrieval.

7.8.3 Creating legacy queries

A terminology server may also support the creation of queries that retrieve data encoded in SNOMED International (SNOMED CT version 3.x), Clinical Terms Version 3 or earlier versions of the Read Codes.
For example, a terminology server may generate a SQL predicate list that includes the Read Codes, CTV3IDs or legacy SNOMED codes of all unique subtype descendants of a specified Concept. Some constraints on this functionality may be necessary as top-level or other general Concepts may generate extremely long lists of descendant Identifiers.

7.9 Creating and maintaining Reference Sets

This section describes the basic steps required to create and maintain Reference Sets.

7.9.1 How to create a new Reference Set using an existing pattern

In order to create a new Reference Set, you will need access to a namespace in order to generate SCTIds. Within your namespace, you should add one moduleId concept (with an FSN and Preferred Term), under the |Module| sub-hierarchy within the metadata, for each of your authoring organisations.

Then, follow the steps below to create a new reference set:

• Define the Reference Set in the metadata hierarchy;
• Define the Reference Set Attributes within the metadata hierarchy;
• Create the Descriptor for the Reference Set;
• Add members to the Reference Set.

**Caution:** All components created during these processes must have unique Identifiers and all those Identifier must be allocated in the correct partition of your organisations namespace. For details see SNOMED CT Identifiers.

7.9.1.1 Define the Reference Set in the metadata hierarchy

First, create a concept for the Reference Set:

Table 278: Reference Set Management Example - Add Reference Set Concept

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>‘1’</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
</tbody>
</table>

Then, add up to three Descriptions for the FSN, the Preferred Term and optionally the Purpose:

Table 279: Reference Set Management Example - Add Descriptions for Concept

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Value</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>conceptld</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the Reference Set that you’ve just added.</td>
</tr>
<tr>
<td>languageCode</td>
<td>String</td>
<td>The language of the Description.</td>
</tr>
<tr>
<td>typeid</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the Reference Set that you've just added.</td>
</tr>
<tr>
<td>term</td>
<td>String</td>
<td>Terms for the FSN, the Synonym and the</td>
</tr>
</tbody>
</table>

Add an | is a | Relationship to link the Reference Set to the appropriate pattern:

**Table 280: Reference Set Management Example - Link to Metadata for Reference Set Pattern**

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>sourceId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the Reference Set that you’ve just added.</td>
</tr>
<tr>
<td>destinationld</td>
<td>SCTID</td>
<td>The concept describing the pattern that this Reference Set follows, a descendant of</td>
</tr>
<tr>
<td>relationshipGroup</td>
<td>Integer</td>
<td>'0'</td>
</tr>
<tr>
<td>typeid</td>
<td>SCTID</td>
<td></td>
</tr>
<tr>
<td>characteristicTypeld</td>
<td>SCTID</td>
<td>Stated relationship</td>
</tr>
</tbody>
</table>
7.9.1.2 Define the Reference Set Attributes within the metadata hierarchy

Add new concepts for each of the Reference Set member attributes, if necessary. If the Reference Set attributes describing the pattern are adequate to describe the Reference Set's attributes, then these can be used instead, and you can skip to the next section.

You may wish to create your own Reference Set attributes for one of the following reasons:

• You wish to give one or more of the attributes a different name than that of the pattern;
• You wish to make the purpose of a particular attribute more explicit in the metadata;
• You wish to limit the set of allowed values for one or more of the attributes;
• You wish to make the type of one or more of the attributes more specific than that given in the pattern.

You may add new concepts for some of the attributes, and reuse existing concepts for other attributes, if you wish.

For each attribute that you wish to create, first add a concept:

Table 281: Reference Set Management Example - Add Reference Set Concept

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
</tbody>
</table>

Then, link it with an | is a | Relationship into the | Reference set attribute | metadata hierarchy.

Table 282: Reference Set Management Example - Link to Metadata Hierarchy

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>sourceId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the Reference set attribute that you've just added.</td>
</tr>
<tr>
<td>destinationId</td>
<td>SCTID</td>
<td></td>
</tr>
<tr>
<td>relationshipGroup</td>
<td>Integer</td>
<td>'0'</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td></td>
</tr>
</tbody>
</table>
Then, add up to three Descriptions (for FSN, Preferred Term and optionally Purpose) for each of the new attributes:

Table 283: Reference Set Management Example - Add Descriptions

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>conceptId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the attribute that you've just added.</td>
</tr>
<tr>
<td>languageCode</td>
<td>String</td>
<td>The language of the Description.</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td>Create up to three Descriptions for each new attribute, with the following types:</td>
</tr>
<tr>
<td>term</td>
<td>String</td>
<td>Terms for the</td>
</tr>
</tbody>
</table>

If any of the Reference Set member attributes are to be limited to a range of values, then add a concept for each allowed value in the range, and link the concept using an Is a relationship to the member attribute. Then add two Descriptions for the FSN and Preferred Term of each allowed attribute value.

In order to limit the range of an attribute, it must have a type of | Concept type component| (as held in the attributeType field of the Descriptor - see the next section).

For each allowed value that an attribute can take, add a concept:

Table 284: Reference Set Management Example - Add Allowed Attribute Value Concept

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
</tbody>
</table>
The module Identifier for your authoring organisation.

Then, link it with an is a Relationship into the attribute that you've just added in the Reference set attribute metadata hierarchy.

Table 285: Reference Set Management Example - Link Allowed Attribute Value to Metadata

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
</tbody>
</table>

And finally, add two Descriptions for the allowed attribute value concept:

Table 286: Reference Set Management Example - Add Description for Allowed Attribute Value

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>sourceId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the allowed attribute value that you've just added.</td>
</tr>
<tr>
<td>destinationId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the attribute that you've just added.</td>
</tr>
<tr>
<td>relationshipGroup</td>
<td>Integer</td>
<td>'0'</td>
</tr>
<tr>
<td>typeld</td>
<td>SCTID</td>
<td>is a</td>
</tr>
<tr>
<td>characteristicTypeld</td>
<td>SCTID</td>
<td>is a</td>
</tr>
</tbody>
</table>
The Identifier of the concept describing the allowed attribute value that you've just added.

The language of the Description.

Create two descriptions, with each of the following types: | FSN |, | Synonym |.

Terms for the | Fully specified name | and a | Synonym |. The | Synonym | will be the string used to commonly refer to the allowed attribute value (and therefore should be the one shown in pick lists used when maintaining Reference Set member records).

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>conceptId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the allowed attribute value that you've just added.</td>
</tr>
<tr>
<td>languageCode</td>
<td>String</td>
<td>The language of the Description.</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td>Create two descriptions, with each of the following types:</td>
</tr>
<tr>
<td>term</td>
<td>String</td>
<td>Terms for the</td>
</tr>
</tbody>
</table>

7.9.1.3 Create the Descriptor for the Reference Set

Add one record to the | Reference Set Descriptor | Reference Set describing the referencedComponentId attribute, and one additional row for each additional optional attribute within the Reference Set.

These records together describe the structure of the Reference Set, and are called the Descriptor of the reference set, for short. If the existing Descriptor Template (that describes the Reference Set's pattern) also adequately describes the reference set that you've just created, then a new Descriptor need not be created, and this section may be skipped.

Where a Descriptor is created for a new Reference Set, it should have the same structure (i.e. - an identical number of records, each of the same attribute type or subtype) as the Reference Set Descriptor that described the parent Reference Set pattern.

Table 287: Reference Set Management Example - Add Reference Set Descriptor

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A unique UUID for this record.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>‘1’</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>9000000000000456007</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>Set to the concept describing the Reference Set that you've just created.</td>
</tr>
<tr>
<td>attributeDescription</td>
<td>SCTID</td>
<td>Set to the concept describing the attribute that you've just created, or alternatively an existing concept under the 900000000000456007</td>
</tr>
</tbody>
</table>
### 7.9.1.4 Add members to the Reference Set

Follow the steps in the next section to maintain the members of the Reference set.

### 7.9.2 How to add, change or remove members of an existing Reference Set

You should only add members to a Reference Set in your organisation's namespace or in the namespace of an organisation that has authorised you to edit that Reference Set and provided you with a moduleId in their namespace to use for that purpose.

To add a member to an existing Reference Set, create a new record as follows:

**Table 288: Reference Set Management Example - Member Added**

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A unique UUID for the new member record.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release that this member is to be first introduced in.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>refsetId</td>
<td>SCTID</td>
<td>The id of the concept that describes the Reference Set that you're adding a member to.</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>A reference to a component, of type (and possibly range) limited by the Descriptor record for this Reference Set with attributeOrder '0'.</td>
</tr>
<tr>
<td>additional field 1</td>
<td></td>
<td>An optional Attribute, with a value, of type (and possibly range) limited by the Descriptor record for this Reference Set with attributeOrder '1'.</td>
</tr>
<tr>
<td>additional field 2</td>
<td></td>
<td>An optional Attribute with a value, of type (and possibly range) limited by the Descriptor record for this Reference Set with attributeOrder '2'.</td>
</tr>
</tbody>
</table>

*Value* set to a *descendant* of 900000000000456007 | Reference set descriptor reference set (foundation metadata concept) | in the metadata hierarchy. This field describes the type of the attribute. If an attribute has been limited to a range of values, then this field must always be set to 900000000000456007 | Reference set descriptor reference set (foundation metadata concept) |. If a Reference Set is the child of a particular subtype of 900000000000456007 | Reference set descriptor reference set (foundation metadata concept) |, this field must be the same as or a descendant of the equivalent field for the more general Reference Set subtype.
To delete an existing member from a Reference Set, create a new record as follows:

**Table 289: Reference Set Management Example - Member Deleted (made inactive)**

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A unique UUID of the existing member record that you wish to delete.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release in which this member is to be deleted.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'0'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>As value in existing record</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>As value in existing record</td>
</tr>
<tr>
<td>additional field 1</td>
<td></td>
<td>As value in existing record</td>
</tr>
<tr>
<td>additional field 2</td>
<td></td>
<td>As value in existing record</td>
</tr>
</tbody>
</table>

To modify an existing member in a Reference Set, create a new record as follows:

**Table 290: Reference Set Management Example - Member Modified**

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>UUID</td>
<td>A unique UUID for the existing member record that is to be updated.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release that the update is to become active in.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>As value in existing record. A member cannot move from one reference set to another.</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>As value in existing record. A member cannot change the component that it refers to. Instead, the existing member record should be deleted, and a new one created.</td>
</tr>
</tbody>
</table>
### 7.9.3 How to create a new Reference Set pattern

In order to create a new *reference set* pattern, follow these steps to create a new *reference set*, with the following exceptions:

- The concept describing the *Reference Set* pattern should be created as an immediate child of the |Reference set| concept, or as a child of another *Reference Set* pattern.
- The Descriptions of type|Id| Synonym | and |FSN| should be of the form:
  - *My pattern name* type;
  - *My pattern name* type reference set (foundation metadata concept).
- A Descriptor Template must be created for a pattern, following the steps as described to create a Descriptor for a *Reference Set*.

### 7.10 Terminology Server Software

This section outlines the possible characteristics of software that provides *Terminology services* through a programmable interface. Such software represents an approach to development that may enable more rapid implementation of *SNOMED CT*.

This guide does not specify a particular *Application Programming Interface (API)* for accessing *SNOMED CT* services. Instead it sets out the general principles and options for delivery and use of a *terminology server*.

#### 7.10.1 Terminology server functionality

A *terminology server* should be able to deliver all the essential *Terminology services* identified in the *Terminology Services Guide (RF2)* (7). It should also provide the recommended *Terminology services* and should achieve a performance that meets the more general requirements for the functionality of *SNOMED CT* enabled applications.

*Terminology server* may provide two types of service:

- Reference Services (see *Figure 132*):
  - Services that do not include a *user interface*;
  - The client application may use reference services to undertake many different functions;
  - For some of these functions the client application will populate an appropriate *user interface component*.

**Example:**

A reference server may return a list of *Descriptions* matching a particular search *string*. The client application may use this data to populate a list from which a user makes a selection.
User Interface (UI) Services (see Figure 133):

- Services that include the one or more user interface components that can be used in and programmatically accessed by the client application.

**Example:**

A UI server may provide a control that includes a text box and a list. When the user types in the text box, the server populates the list and allows the user to select an item. The selected item is accessible from the client program.

- One possible type of UI service is a SNOMED CT browser with an API for returning selected data to a client application:
  - This may be useful as mechanism for providing some SNOMED CT capabilities to an application. However, it is less suitable for frequent entry of SNOMED CT encoded information.

![Figure 132: Terminology server providing reference services to a client application](image)
7.10.2 Terminology server APIs

This guide does not specify a particular API. The services specified in this guide may be delivered using various types of interfaces based on a range of different technologies including:

- Web services such using WSDL (Web Services Description Language) or REST (Representational State Transfer) interfaces;
- Java components such as JavaBeans™ or Eclipse plug-ins;
- Microsoft .NET® or Active -X® / COM / DCOM in Microsoft Windows® environments;
- CORBA® (Common Object Request Broker Architecture).

Decisions on which technologies to support depend on the intended functionality, performance, accessibility, ease of use and support requirements for maintenance or updates.

Over the past two decades there have been various efforts to specify standards for terminology servers and related APIs. The most recent development in this area is centered around the Common Terminology Server Release 2 (CTS2). The requirements initially identified and documented within HL7 have now led to an OMG (Object Management Group) proposal. At least one of the responses to this proposal focuses directly on SNOMED CT related requirements. The OMG process is expected to result in a detailed specification and prototype implementation during 2011.
Chapter 8

8 Record Services Guide

The following sections discuss requirements for record services that support entry, storage, retrieval and communication of SNOMED CT encoded information. The services are illustrated by Figure 134.

The primary use of SNOMED CT is to enable information to be entered in a health record and stored in a manner that enables selective retrieval. Effective selective retrieval is required to support aggregation, analysis and decision support. Information in a health record may need to be communicated in the interests of the patient or to enable larger scale aggregation and analysis. Communication of information should convey the information expressed using SNOMED CT expressions in ways that preserve the semantics and thus enable recipient systems to process the information effectively.

Figure 134: SNOMED CT Enabled Record Services

8.1 Entering Expressions

SNOMED CT enabled applications must facilitate the entry of SNOMED CT expressions in ways that allow users to capture relevant information easily and accurately. This section considers various methods that may be used to enter SNOMED CT information into a record. These data entry methods require the Terminology services specified in the Terminology Services Guide (7).
8.1.1 Using text searches and subtype hierarchy navigation

8.1.1.1 Selection in a browser

The starting point for a consideration of data entry is an efficient method for performing text searches and subtype hierarchy navigation. When these functions are integrated in a terminology browser, it is possible to select a Concept by text search and then to refine or generalise the selection to identify a more appropriate Concept for recording.

A terminology browser built into an application or offering a programmable interface can be used to allow a user to select a Concept (and/or Description) and enter this into a record.

This method of data entry allows unconstrained selection of any Concept from SNOMED CT. This can sometimes be useful but such an unrestricted method should only be used as a fallback, when more selective approaches cannot be used.

8.1.1.2 Limitations of simple browsers

A general-purpose browser capable of searching and navigating through the SNOMED CT hierarchy is a simple starting point. However, this approach is unlikely to meet the requirements for anything other than occasional entry of SNOMED CT encoded information. More selective mechanisms tailored to particular data entry contexts are likely to be more usable and may promote more consistent data recording.

In most situations in which clinical data is entered, access to the full content of SNOMED CT through a simple search and hierarchy browser is unlikely to be necessary and may be cumbersome and unhelpful. The main reason for this relates to the size and structure of the terminology. As a result:

• Many terms may match a single word or short phrase resulting in a long list of options;
• The depth and breadth of the subtype hierarchy and navigation may require selection of choices from several screens to locate the required Concept.

There are many ways to improve and simplify SNOMED CT data entry. Some of these can be used in a wide range of situations. Others are specific to constrained contexts that occur in structured data entry driven by a template or protocol.

Optimising searches for data entry

8.1.2.1 Extending searches and limiting duplication

The Terminology services guide addresses ways of:

• Extending text searches to include similar words and phrases by making use of the Word Equivalents Table;
• Rationalising text searches, which, in a simple search, return the same Concept more than once due to multiple matching Terms.

These techniques may be used to improve access to Concepts during data entry.

8.1.2.2 Searches with qualifier resolution

When typing text for a search, the user is unlikely to know if their intended entry can be represented by a single Concept or requires a postcoordinated expression involving additional Concepts or qualifiers. Where searches fail to find a precoordinated match, expansion of the search to support appropriate or commonly used qualifiers is likely to enhance usability.

Some terminology servers may provide a general facility of this type. Alternatively, a limited facility for recognising commonly qualifying words may be used. For example, words such as "left," "right," "routine," "emergency" and "severe" are applicable as qualifiers when not included in a precoordinated Concept.

8.1.2.3 Real time searching

Conventional text searches require the user to decide how many words to enter and then explicitly request a search. When a search fails to find any matches or returns a very long list of matches,
the user is obliged to repeat the process. The need to undertake this type of user interaction for every coded entry is likely to create a significant disincentive to effective data entry.

One possible solution to this is an interface that performs real-time checking of the number of matches as the user types. The interface may indicate this to the user, allowing them to decide when to stop typing and commence the search. A further enhancement is to automatically return the list of matches whenever the user stops typing, or when the number of matches reduces to an acceptable level.

8.1.2.4 Background encoding

Techniques that support real-time searches and qualifier resolution may also be extended to enable background encoding of complete sentences as they are entered. This method can be applied to text entered by typing or by voice recognition.

As text is entered, the search mechanism attempts to narrow the selection. If this process eventually finds a single good match, this is used to encode the text. The match should be displayed allowing the user to override it, but the default action is to accept the encoding. If at the end of a sentence there are multiple possible matches, then these are presented for user selection.

There are many possible variants on this technique. For example, as the possible matches are narrowed down, the system could offer an auto-completion option similar to that used in web browsers and word-processors.

**Caution:** Anyone implementing this approach should take care to undertake appropriate quality assurance of the results. Mention of this approach to data entry does not imply that it is considered safe for a given use-case. Formal professional assessment of the risks and benefits of any type of automated encoding is essential.

8.1.2.5 Automatic and semi-automatic encoding

Techniques similar to those used for background encoding can be applied to previously entered text or to text entered by voice recognition or optical character recognition. Where such methods are used there is likely to be a need for manual intervention to resolve uncertain encoding. The requirement for manual intervention will depend on the sophistication of the matching techniques and the extent to which accuracy is safety-critical. If encoded data is to be used by clinical decision support protocols, which may influence the treatment of a patient, extreme care is needed when using automatic encoding and tools that allow manual review are essential. A less rigorous approach may be acceptable where the purpose of encoding is for aggregation and analysis of large volumes of population data.

**Caution:** Anyone implementing this approach should take care to undertake appropriate quality assurance of the results. Mention of this approach to data entry does not imply that it is considered safe for a given use-case. Formal professional assessment of the risks and benefits of any type of automated encoding is essential.

8.1.2.6 Mnemonics and personal favourites

Groups of people, such as practitioners of a discipline or specialty, frequently use similar sets of Descriptions and Concepts. Lists of widely understood (or easily learnt) abbreviations or mnemonics that allow rapid entry of these commonly used concepts are recommended as a way of accelerating repetitive recording.

A similar facility may also be useful for individual users or organisations that have sets of Descriptions and Concepts that they use frequently. An easy way to use options to store and recall personal favourites with user-defined abbreviated access terms will enhance usability and significantly increase the speed of data entry.

User guidance may be necessary to minimise the risk of shortcuts such as these being overused. Unless the general search facilities are also easy to use, it is likely that users will favour the shortcuts even when it would be more appropriate to use a more accurate but less accessible Concept. An unchecked bias towards easy to record Concepts may lead to deterioration in data quality, statistical anomalies, and in the worst case, inappropriate treatment.
8.1.3 Constraining searches for data entry

8.1.3.1 Constraining searches by status

In Release Format 2 the value of the active field determines whether a concept or description is intended for active use. Searches should usually be filtered to exclude terms associated with Inactive Descriptions or any descriptions applied to an Inactive Concepts.

There are a few cases where a user may legitimately wish to search Inactive Concepts and Descriptions. Possible reasons for this include creating or editing queries that locate previously entered data recorded using Concepts and Descriptions that are no longer recommended for active use. Therefore, it should be possible to disable the active field search filters.

8.1.3.2 Constraining searches by subtype ancestors

Searches may usefully be limited to Concepts that have a specified supertype ancestor, which is appropriate for the context of a particular field, template or protocol.

Example: When attempting to record the diagnosis "renal calculus," it is not helpful for a search to include the procedures that may be carried out to treat a renal calculus.

8.1.3.3 Constraining searches by Reference Sets

Searches for Descriptions or Concepts may need to be constrained by Reference Sets. Applications should allow searches to be filtered, ordered or otherwise prioritised in accord with one or more active Reference Sets. Specifically, the search mechanism should support the following functions with respect to the following types of Reference Sets:

- Filtering of search and navigation results to include only those Descriptions that are referenced by the Language Reference Sets may be applied to limit a search to those Descriptions applicable in a particular language or dialect.
- A Simple Reference Set may be used to filter, sort or highlight the results of text search or hierarchical navigation. This may simplify or encourage selection of Concepts or Descriptions used in a particular country, organisation or specialty.
- A Simple Reference Set or an Ordered Reference Set may be used to specify or order the valid Concepts for entry in a particular field.

8.1.4 Constraining and extending hierarchical navigation for data entry

8.1.4.1 Using the subtype hierarchy for data entry

The most visible hierarchical construct in SNOMED CT is the subtype hierarchy. This is constructed using a set of logical rules. The purpose of this hierarchy is to support data retrieval and aggregation by addressing the question "is concept -A a subtype of concept -B."

The same hierarchy can be used for data entry navigation but it is not designed for this purpose. Its depth and breadth are determined by logical rules of subsumption rather than by usability. As a result:

- There is no upper limit on the number of subtypes a Concept may have. This is true because there is no rule that determines the number of subtypes that a real world concept may have. However, long lists of options are not conducive to effective data entry.
- There is no fixed limit to the number of hierarchical steps between a generalised Concept and its most refined subtype. This is true since there is no preordained limit on the extent of possible refinement of a real world concept. However, data entry procedures that involve stepping through several levels of choices before reaching the required selection impair usability.
- The subtypes of a Concept do not have any particular order. The | is a | Relationship is primarily a property of the subtype Concept and does not express an ordinal position. This is true because logical subtypes are inherently an unordered set. However, a user is likely to find it easier to locate their required selection if members of hierarchical lists are displayed in some recognizable order.
• The issues of depth, length and order noted above are also subject to change between releases. The addition of an intermediate Concept or reclassification after the addition of new defining characteristics will introduce new layers in the hierarchy. Some Concepts will then move from the list of immediate subtypes of a Concept to become subtypes of a more refined Concept. Hierarchical changes may sometimes simplify navigation by reducing the number of choices at a given hierarchical level. However, the general effect of improvements in the subtype hierarchy will be to increase its depth and thus to increase the number of steps from a particular general Concept to its most refined subtypes.

• The nature of a subtype hierarchy means that there may be many routes from a given Concept to its more general descendants. This means that some of the choices presented for user selection are redundant since they simply offer alternative routes to the same Concept.

Routine use of subtype hierarchy navigation is not recommended for data entry. However, despite the drawbacks listed above, the subtype hierarchy may be useful for undertaking an exhaustive search for a particular refined Concept.

Example:

The Concept “Laparoscopic emergency appendectomy” can be reliably located by subtype navigation from any of its supertypes: “appendectomy,” “laparoscopic appendectomy” or “emergency appendectomy.”

8.1.4.2 Using Ordered Reference Sets to support data entry

Ordered Reference Sets provide alternative hierarchical representations of SNOMED CT. They are intended to support data entry by addressing the limitations of the subtype hierarchy discussed in the previous section.

• Usability constraints can be placed on the number of levels in the hierarchy and the number of options displayed at each level in the navigational hierarchy:
  • If there are relatively few options and many layers, the most common options can be brought to a higher level.
  • If there are long lists of options, these may be subdivided with less frequent options moved to lower levels.
  • Options that are rarely or never used by a particular user community can be excluded from a navigational hierarchy to limit the range of choices. According to requirements, these options may remain accessible by switching to a subtype view.

• Options at each hierarchical level can be ordered to meet the expectations of users and/or to facilitate rapid access to commonly used options.

An Ordered Reference Set may be based on the foundation of the SNOMED CT subtype hierarchy. This can then be modified to add ordering and other features discussed above. An alternative starting point is a hierarchy of classification derived from another coding scheme or classification.

Note:

An Ordered Reference Set derived from the Clinical Terms Version 3 hierarchy is provided with the SNOMED CT Developer Toolkit as an example.

Alternative Ordered Reference Set can be created from scratch (or as variants of a common source hierarchy) to provide views to support users with different requirements. Since Navigational Hierarchies do not affect interpretation, retrieval and aggregation, data entered in using different views can be analysed consistently.

8.1.5 Constraining data entry

Some Concepts or Descriptions displayed by searches, hierarchical navigation or other methods of data entry may not be suitable for recording in a patient record. Various reasons for this are discussed in the following sections. They include:

• Status of the Concept
8.1.5.1 Excluding inactive concept and descriptions

In Release Format 2 the value of the active field determines whether a concept or description is intended for active use. Inactive Concepts should not be added to a record. Similarly, terms associated with Inactive Descriptions or any descriptions applied to an Inactive Concepts not be added to a record.

8.1.5.2 Excluding Special Concepts and Model Components

Concepts that are subtypes of the top-level Concept 370115009 | Special concept | (RF1) or 900000000000441003 | SNOMED CT Model Component | (RF2) are rarely if ever required in clinical end-user searches. Therefore, they should be excluded from text searches except where explicitly needed to meet a particular requirement (e.g. to display a Namespace concept |, a Linkage concept | or a Navigational concept |).

8.1.5.3 Constraining data entry according to subtype relevance

It may be necessary to prevent entry of a Concept in a subtype hierarchy that is inappropriate to a particular data entry field or to a particular part of a patient record. For example:

- An application should not allow a disorder Concept to be recorded in a field intended for recording a procedure (or vice-versa);
- An application should not allow a Concept that is a subtype descendant of the top-level Concept "attribute" to be recorded, except to associate another Concept with an appropriate qualifying value;
- An application should not allow a Concept that is a subtype descendant of the top-level Concept "qualifier value" to be recorded, except where it qualifies an appropriate attribute Concept.

8.1.5.4 Constraining data entry using Reference Sets

In some cases, identifying selected portions of the SNOMED CT hierarchy may be a sufficient constraint for entering data into a record. However, that is not always sufficient if Concepts from multiple hierarchies are required, or if there is a need to hone down the entry options from the full hierarchy. To meet these requirements applications should allow data entry to be constrained by Reference Sets.

Applications should be able to:

- Permit or prevent the entry of Concepts or Descriptions that are members of a specified Simple Reference Set.

Example:

A UK GP system might:

- Prevent the entry of Concepts in a Simple Reference Set that contains all Concepts that are non-human;
- Enable the entry of Concepts in the "UK Administrative Reference Set" only when entering information in an administrative context.

- Encourage or inhibit the entry of Concepts or Descriptions according to their order in an Ordered Reference Set.

Example:

A specialty system might prompt for confirmation when the user records a procedure not in a specified specialty Simple Reference Set.
8.1.5.5 Constraining data entry based on mappability

One of the requirements for some applications may be that the data recorded in particular fields has to be mapped to a particular classification or grouping scheme.

One way to simplify this process is for the application to check mappability at the time of data entry. If a selected Concept has no unambiguous map, the application may encourage or compel the user to refine their selection until a mappable Concept has been selected.

This type of facility should not be applied in situations where it may inappropriately affect the perceived accuracy or detail of a clinical record.

8.1.5.6 Constraining data entry based on context

All fields (data elements) used for data entry must be analysed to understand what underlying context is implied. The appropriate concepts should then be selected for the value set of each field. Concepts from the Clinical Findings, Procedures, and Observable entities hierarchies can be used directly if the default assumptions are true. Otherwise, concepts from the Concept-Dependent hierarchy should be selected.

Particular care must be taken with systems that enable postcoordinated constructs to ensure that the appropriate context attributes are included.

To precoordinate concepts that do not already exist in SNOMED CT, care must also be taken to determine if any axis modification is shifting the meaning of a concept so it should move to the Situation with explicit context hierarchy.

8.1.5.7 Absolute and configurable constraints

Some of the constraints on data entry discussed in the preceding sections are absolute while others should be configurable.

• An application should not allow Inactive Concepts or any Special Concepts to be recorded.

Constraints based on subtype hierarchies, Subsets and other Reference Sets including maps to other terminologies or code systems should usually be configurable to particular institutions, users and/or data entry fields.

8.1.6 Configuring and applying data entry constraints

The previous sections describe various mechanisms for extending and constraining search and navigation during data entry. The scope of applicability of these facilities varies and these variations affect the way in which they may be implemented.

A few constraints apply to all data entry events in a particular application. These fixed constraints could be hard-coded in the application or explicitly optimised when importing and indexing SNOMED CT content.

Example:

One example is to exclude Inactive Concepts and Descriptions from searches. Before building this type of facility into an application, care should be taken to consider circumstances, such as creation and editing of queries where access to Inactive Concepts may be required.

Most search constraints are to some extent configurable and these require greater flexibility in the application design. There are several types of configurability that may be required. These range from installation configuration to context-specific dynamic configuration.

8.1.6.1 Installation configuration of data entry

Requirements of an organisation that are general to all users may be applied when installing the application or when importing or indexing SNOMED CT content. These may include:

• Language Reference Set which constrain searches to the local language and dialect.
• Simple Reference Sets which apply national or organisation constraints applicable to all users of the application.
• Simple Reference Sets which apply constraints applicable to all the clinical disciplines or specialties that use the installed system. For example, installations that are not intended for use in veterinary medicine will apply Reference Sets that exclude specific veterinary Concepts and Descriptions.
• An Ordered Reference Set that provides a data entry hierarchy appropriate to the needs of all users within an organisation.

8.1.6.2 Log-on configuration of data entry

The application should allow search constraints that are specific to a particular user or group of users when loading or logging on to an application. The range of possible search constraints may be preset at installation but it should be possible to apply the user profile constraints without a significant delay. Uses of this type of configuration include:
• Simple Reference Sets which apply constraints or optimisations applicable to a particular specialty;
• Ordered Reference Set that provide a restricted or extended data entry hierarchy appropriate to the needs or preferences of a particular specialty or user;
• Language Reference Set that meet the needs of particular users in a multi-lingual environment.

Consideration should be given to requirements for this type of search configuration to be modified by a user or system administrator.

8.1.6.3 Dynamic reconfiguration of data entry

Constraints that assist fast and consistent routine data entry may sometimes need to be relaxed to enable more complex entries to be made.
• If a Ordered Reference Set limits the scope of hierarchical navigation, the application should enable the user to utilise the subtype hierarchy to allow other options or a more complete set of options to be reviewed;
• If a user is unable to locate the Concept that they require, it may be useful to enable some or all of the search constraints to be temporarily lifted.

8.1.6.4 Context-sensitive of data entry constraints

Some constraints may apply to particular data entry contexts. To support this type of functionality, an application should be able to switch between sets of search constraints in real-time. The constraints need to change instantly as a user moves between different data entry fields. Context-dependent constraints may include:
• Limitation of a search to subtype ancestors of an appropriate Concept.

Example:

A field for entry of a procedure may be associated with a constraint that limits searches to subtypes of the Concept "procedure."

• Limitation of a search to the Concepts or Descriptions that are members of an appropriate Simple Reference Set.

Example:

A field for entry of a laboratory service request may constrain searches to a list of valid investigations supported by a particular laboratory.

• Use of a particular Ordered Reference Set or an specified sub-branch of an Ordered Reference Set:

This is an alternative approach that may be used to allow more sophisticated control of data entry in a particular context.
8.1.7 Entering qualifiers and other postcoordinated representations

SNOMED CT contains many precoordinated Concepts that allow fairly complex Concepts to be represented by a single Concept Identifier. It also permits the qualification or refinement of Concepts to represent more detailed Concepts by postcoordinated combinations of several Concept Identifiers.

Several types of postcoordinated data are outlined in this section from the perspective of data entry. These include refinement, qualification and combination. The requirements for and relevance of each of these will depend on decisions about data representation within patient records.

8.1.7.1 Entering refined defining characteristics

The application may allow a user to refine a Concept by selecting a subtype of one of its defining characteristics.

Example:

One of the defining characteristics the Concept | total replacement of hip | is | using | = | hip prosthesis.

The Concept | total replacement of hip | could be refined by allowing the user to specify one of the subtypes of "hip prosthesis."

Refinement options may be entered by selecting from hierarchical lists showing subtype values for each of the refinable characteristics. Simple lists or option buttons could support selection from limited sets of possible refinements. Wider ranges of potential refinement could be facilitated by text searches constrained to subtypes of one or more of the refinable characteristics.

Caution:

Some concepts should not be refined if the result means the new concept is not a subtype of the parent concept.

This situation occurs when context such as “Family history” or | Planned Procedure | is attached to a Clinical Finding or Procedure. "Family history” of a Clinical Finding needs to be defined in the situation with explicit context hierarchy. All postcoordinated constructs should consider the impact of context.

8.1.7.2 Entering concept model refinements

The application should allow a user to refine the meaning of a concept by selecting an attribute permitted by the concept model and applying an appropriate value to that attribute. The attributes permitted for a concept depend on the domain in which that concept falls (i.e. its position in the subtype hierarchy). Similarly, the set of values that can be applied to an attribute range specified for that attribute.

8.1.7.3 Entry of unsanctioned qualifiers

The application may also permit refinement of a concept by the addition of attributes and values that are not sanctioned by the concept model. However, this is not recommended as it results is inconsistency between representation of meaning in different systems. Any facility to allow qualification of concepts in this way carries a risk of creating nonsensical or contradictory statements. It may also result in incomplete or inappropriate retrieval where the qualifier significantly affects the meaning of the concept.

8.1.7.4 Constraints on the entry of refinements

Refinements should only be used where the result of applying them results in a true subtype of the original Concept. Therefore, refinement should not be used for the following purposes:

• Negation.

Example:

| Fracture of humerus | should not be qualified by "excluded."

It would be inappropriate for data retrieval to treat this as a subtype of the clinical finding | Fracture of humerus |.
• Certainty.

Example:

| Carcinoma of cervix | should not be qualified by "possible."

It would be inappropriate for data retrieval to treat this as a *subtype* of the diagnosis of | Carcinoma of cervix |

• Subject of information.

Example:

| Diabetes mellitus | should not be qualified by "family history."

It would be inappropriate for data retrieval to treat this as a *subtype* of the diagnosis of | Diabetes mellitus | in the patient.

• Planning stage.

Example:

"Hip replacement" should not be qualified by "planned" or "requested."

A count of "Hip replacement" operations performed should not include this. Decision support protocols should not assume the patient has had this operation.

These and similar major modifications need to be handled in ways that are explicit and ensure that queries and decision support protocols are able to accurately retrieve and analyse the available information.

**8.1.7.5 Entry of concepts combinations**

The application may allow other combinations of Concepts in a single statement where a Concept that represents the full scope of an activity is not available. This approach might for example be applied where a single procedure, which lacks a precoordinated SNOMED CT representation, is a combination of two procedures that can be separately represented in SNOMED CT.

Facilities for entering combined Concepts should be implemented and used with care. It is appropriate to use these facilities when the combined result is conceived as a single statement that could potentially be used in many different patient records.

Example:

A diagnosis of "gallstones with cholecystitis" could be entered by selecting the "gallstone (disorder)" 235919008 and then selecting | cholecystitis (disorder) | 76581006 and combining these in a single statement 34.

It is not appropriate to use these constructs to attempt to express an entire encounter, episode or clinical history in a single statement.

Example:

If a patient is treated for "gallstones with cholecystitis" diagnosed by "ultrasonography of biliary tract" with a course of | amoxycillin | followed after the acute phase has resolved by a | cholecystectomy |, this should not be entered as a single complex postcoordinated statement combining the diagnosis, investigation and treatments.

**8.1.8 Template and protocol driven data entry**

In many healthcare disciplines similar data sets are collected for each patient. Clinical consultations for many conditions involve repeatable sequences of data entry. These structured and predictable data entry requirements can be met using sets of customised data entry fields or forms (templates) designed to collect particular data items. These data entry templates may be presented in a predefined sequence, as

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34 There is also a precoordinated Concept "Calculus of gallbladder with cholecystitis" which is equivalent to this postcoordinated combination.
selected by the user. Alternatively the sequence of data entry may follow a branching pathway with
previously entered data determining which branches are taken (protocols).

When using a structured data entry mechanism, SNOMED CT encoded data can be selected in a variety
of ways. Some of these involve direct selection of Concepts and Descriptions while in others the encoding
may result from responses to simple choices or entry of particular data values. The following list outlines
some of the possible mechanisms for SNOMED CT encoding during structured data entry:

- User selection from a small list of possible Descriptions applicable to a particular field in a template
  or step in a protocol:
  - A Simple Reference Set with Descriptions as members or a Language Reference Set may specify
    the set of applicable Descriptions.

- Text search limited to a set of Concepts applicable to a particular field in a template or step in a protocol:
  - A Simple Reference Set may specify the set of applicable Concepts;
  - Alternatively the applicable Concepts may be specified as the subtype descendants of a single
    Concept.

- Association of a Concept with particular options presented by a check box, option button or other data
  entry control:
  - When selections are made using this control the appropriate Concept Identifier is added to the
    record.

- Association of a Concept with a data control used for entering a numeric or other value:
  - When a value is entered in this control it is labelled, with the appropriated Concept Identifier.

- Association of a Concept with a particular combination of values or the result of a computation involving
  several items of previously entered data:
  - In its simplest form this is an extension of one or both of the previous options;
  - In some applications, information derived from the user-entered data, by decision support tools,
    may be encoded in this way.

Some installations allow free text to be entered at point of care if a needed concept is not included in the
predefined short list. This text is then reviewed by trained staff who can then search and find the appropriate
Concept, request the addition of a new Concept, and/or request that the Concept be added to the template’s
short list for future use. The success of this option relies upon trained staff who are available to do the
review on a timely schedule, and the willingness of the clinician to use this approach sparingly, as it is
greatly preferred to choose the appropriate concept and not enter free text.

### 8.2 Storing Expressions

SNOMED CT enabled applications must support the storage of SNOMED CT expressions in ways that
represent relevant information within the record system. This section is concerned with the different
approaches that may be used to store expressions in ways that enable them to be subsequently retrieved,
displayed, processed and communicated.

The term SNOMED CT expressions includes also single Concept Identifier expressions, that identify only
one specific concept. Even when postcoordination is not supported in an implementation, each time a
single Concept Identifier is being assigned to a clinical record it represents a way of using a SNOMED
CT expression.
8.2.1 precoordinated and postcoordinated representations

8.2.1.1 precoordination

The simplest form in which any concept can be stored is as a single Identifier. This is referred to as a precoordinated expression, because all aspects of a potentially multifaceted concept are precoordinated into a single discreet form.

SNOMED CT contains more than a quarter of a million concepts, and thus allows a wide range of clinical statements to be expressed in precoordinated form.

Example: Laparoscopic emergency appendectomy - precoordinated

A precoordinated expression 174041007 | laparoscopic emergency appendectomy | can be used to record an instance of this procedure.

The procedure "Laparoscopic emergency appendectomy" has at least three distinct facets: "removal of appendix", "using a laparoscope" and "as an emergency procedure". SNOMED CT includes a concept that precoordinates these facets.

The concept 174041007 | laparoscopic emergency appendectomy | has the following defining characteristics:

- 260870009 | priority | = 25876001 | emergency |
- 116680003 | is a |=80146002 | appendectomy |
- 425391005 | using access device | = 86174004 | laparoscope |

8.2.1.2 postcoordination

A multi-faceted concept can be stored using a combination of Identifiers for its individual facets. This is referred to as postcoordination, because the various aspects of the concept are coordinated during data entry rather than in the preparation of the terminology. Three types of postcoordination are described in the following sections.

8.2.1.3 postcoordination by refinement

Refinement is a type of postcoordination in which a concept is made more specific by refining the value of one or more of the defining attributes of the concept.

Example: Total replacement of hip using a Sheehan total hip prosthesis - postcoordinated

A postcoordinated expression based on the concept 52734007 | total hip replacement | can be used to record an instance of this procedure. The definition of this concept includes 363699004 | direct device | = 304120007 | total hip replacement prosthesis | and the value of this attribute can be refined to 314580008 | Sheehan total hip prosthesis | (which is a subtype of 304120007 | total hip replacement prosthesis |). Therefore, the following postcoordinated expression can be created and used to represent this procedure:

52734007 | total hip replacement | : 363699004 | direct device |=314580008 | Sheehan total hip prosthesis |.

Another common use of refinement is to represent a situation such as a family history, or a planned procedure. In this case, a concept representing the general type of situation can be refined by applying a clinical finding or procedure.

Example: Family history of temporal arteritis - postcoordinated

A postcoordinated expression based on the concept 281666001 | family history of disorder | can be used to record a family history of any disorder. The definition of this concept includes 246090004 | associated finding |=64572001 | disease | and the value of this attribute can be refined to 400130008 | family history of disorder |.

35 In practice the relationship 116680003 | is a |=80146002 | appendectomy | is represented via intermediate supertype and is also represented by the following defining characteristics 260686004 | method |, 405813007 | procedure site - Direct | = 66754008 | appendix structure |.
temporal arteritis | (which is a subtype of 64572001 | disease |). Therefore, the following postcoordinated expression can be created and used to represent this family history:

281666001 | family history of disorder | : 246090004 | associated finding |=400130008 | temporal arteritis |.

8.2.1.4 Postcoordination by qualification

Postcoordination by qualification is a type of postcoordination in which a concept is made more specific by applying value to attributes that are permitted by the Concept Model. Unlike refinement, the attributes applied need not be present in the definition of the concept that is being qualified.

Example: Laparoscopic emergency appendectomy - postcoordinated

A postcoordinated expression based on the concept 80146002 | appendectomy | can be used to record an instance of this procedure by separately specifying the access instrument and priority. The concept 80146002 | appendectomy | does not have defined values for the attributes 260870009 | priority | and 425391005 | using access device |, but the Concept Model permits these to be added to subtypes of 71388002 | procedure |. Therefore, the following postcoordinated expression can be created:

80146002 | appendectomy | :260870009 | priority | = 25876001 | emergency | , 425391005 | using access device |= 86174004 | laparoscope |

This postcoordinated expression is equivalent to the definition of the concept 174041007 | laparoscopic emergency appendectomy |. However, the postcoordinated approach can also be applied to procedures for which there is no precoordinated concept.

8.2.1.5 postcoordination by combination

Example:

"Gallstones with cholecystitis" could be represented by combining the concepts for the disorders "gallstones" and | cholecystitis | as a single postcoordinated statement. Neither of these concepts is really a qualifier of the other since it could equally well be regarded as | Calculus of gallbladder with cholecystitis |.

SNOMED CT allows Concepts to be combined in postcoordinated statement.

Combinations like this should only be used to represent concepts that can be regarded as discreet reusable clinical statements. They should not be used to construct arbitrarily complex representations of multiple statements to a particular record.

Some concepts, such as the first and last examples above, can be represented in either a postcoordinated or precoordinated form. However, there are other concepts, like the second example above, for which no precoordinated Concept exists in SNOMED CT. Although future releases of SNOMED CT will include new precoordinated Concepts, there will always be some clinical Concepts that require postcoordination.

8.2.1.6 Representing postcoordination

This guide does not specify a single right way to represent postcoordinated expressions. Alternative representations have different profiles of advantages and disadvantages. The choice of representation depends on functional requirements including performance, information model of the software application and the communication standards to be supported.

Some alternative representations are summarised below. These summaries illustrate some of the main options and do not go into extensive technical detail. Detailed design may lead to further alternatives that are not documented here.

Each of the following summaries assumes that SNOMED CT expressions are stored in (or associated with) one or more fields within particular types of record entry. The expression is only one part of the data in that record entry.
8.2.1.6.1 Parsable text representation

A way to represent postcoordinated SNOMED CT information as a simple parsable text string is summarised below:

• Each clinical statement is recorded as a row in a relational database table (or as an element in an XML document);
• The schema for representation of clinical statements contains a field (or element) for representation of the SNOMED CT expression;
• The expression field (or element) contains a text string that is formatted in accordance with the SNOMED CT compositional grammar.

8.2.1.6.2 Unrestricted relational representation

An unrestricted relational database representation of a postcoordinated expression requires that a data item that may be expressed using SNOMED CT is modelled in a way that permits an indeterminate number of attribute-value pairs to be appended to a focus concept. In addition, the value within each attribute-value pair must be able to be refined by addition of nested attribute-value pairs.

This offers a flexible and extensible approach but adds significantly to database design complexity. Disadvantages arising from this complexity include storage capacity requirements and the impact on writing queries and retrieval performance.

8.2.1.6.3 Restricted relational representation

An alternative restricted relational representation of postcoordinated SNOMED CT information is summarised below:

• Each clinical statement is recorded as a row in a relational table.
• The clinical statements table contains a field for a Concept Identifier.
• The clinical statements table also contains fields for a specified number of qualifiers. These fields may be provided in different ways:
  • Each qualifier is represented by two Concept Identifier fields (one for the attribute and one for the value) and an optional field for Relationship group field. With this option the only restriction is the total number of qualifiers or modifiers that can be stored for each Concept.
  • Each qualifier is represented as a single Concept Identifier and carries the value of a qualifier attribute specific to that field. This restricts the usable qualifiers to those specified in the database schema.
  • Similar to above, but with different sets of qualifying attributes available according to the semantic type of the primary Concept in the statement. There are various ways of implementing this approach to ensure that the appropriate interpretation is applied to each row of the table.
• Combined Concepts may be represented by explicitly combining two rows of the clinical statements table.

Unlike the representations discussed in previous subsections, this approach limits the expressivity of postcoordinated statements. The advantage of this restricted approach is that it reduces the number of joins involved in retrieval queries. In some software environments this may significantly improve performance.

The balance between demands for flexibility and performance depends on user requirements. Therefore, limitations in expressivity may be acceptable for some users or user communities but not for others. However, it should be noted that these limitations might cause difficulties when communications are received from systems that support richer forms of expression.

8.2.1.6.4 XML Representations

A way to represent postcoordinated SNOMED CT information as an XML element is summarised below:

• Each clinical statement is recorded as a row in a relational table or as an element in an XML representation.
• The clinical statements table (or element) contains a field (or element) for representation of the concept.
• The concept field (or element) contains an XML expression that encapsulates a postcoordinated representation of the concept according to a parsable syntax specified for this purpose:
Various alternative XML representations could fulfil this role.

8.2.1.6.5 Representation as precoordinated content

In some implementations, expressions are stored as precoordinated content, with new concepts, Descriptions and Relationships in an extension namespace.

User input includes also a text label for the expression, and the new concept is created, usually a team of expert SNOMED CT modelers review the new concept for quality assurance. Other implementations require that user enter only the text label, and then the modelers team can associate the label to an existing concept, or create a new concept in a local extension using the label as a Description and adding the new Relationships for the concept definition.

This approach is called Managed Content Additions (MCA). Has some advantages like having all new content available for text searches by users, and allowing the use of a description logics classifier for inferring Relationships and super-types, avoiding the need of complex real-time expressions computations. On the other having a centralized team of experts represents an expensive approach and a possible bottleneck for terminology development, as the experts need to review all content additions in the system.

8.2.1.7 Storing and retaining original expressions

Transforming an expression to a normal form may be necessary to support effective data retrieval. However, even quite small minor corrections to the definition of a concept in future releases may significantly alter the resulting normal form of the same expression.

Therefore, it is recommended that:

- The primary or original record should be stored using the representation that is as close as possible to the form in which it was recorded.
- If transformations to alternative representations are used to enhance the efficiency of retrieval, these should be stored as secondary supporting tables or indices:
  - This has the advantage that these alternative forms can be regenerated based on the most up to date set of definitions when a new release of SNOMED CT is installed, without affecting the integrity of the original records.

8.2.2 SNOMED CT storage issues for electronic health records

8.2.2.1 Storing Concepts in electronic health records

Information in an electronic health record should accurately reflect the way it was recorded by its author. If the author of a statement in the clinical record chooses a particular form of representation the system should faithfully store the information in that form.

Following this principle, the recommended approach for representation of SNOMED CT in a electronic health records is as follows:

- If, during data entry, an author selects a single precoordinated Concept to represent a clinical statement, the Identifier of that Concept should be stored in the record:
  - This form of representation should remain as the original record of that statement. It should not be replaced by an apparently equivalent postcoordinated transformation of this Concept.

- If, during data entry, an author constructs a clinical statement by selecting a Concept and one ore more qualifier values, refinements or additional Concepts, the Identifier of all the relevant Concepts should be stored in the record in a manner that reflects the relationships between them:
  - This form of representation should remain as the original record of that statement. It should not be replaced by an apparently equivalent transformation of this Concept into a precoordinated or differently constructed postcoordinated form.

An application should prompt for author endorsement of any alternative form of representation that it proposes to store in the original electronic health record. In this case, if the author accepts the alternative form presented by the application, this form should be stored as the original record.
The forms in which a technical implementer may wish to store data for efficient retrieval may differ from the forms dictated by the principles appropriate to storage of original entries in an electronic health record. However, it is recommended that any retrieval-orientated representation should be derived from rather than replace the original form of the record.

8.2.2.2 Storing terms

A electronic health record should also store the terms that were actually displayed to and selected by the author of the record. In some Realms the Description Identifier may be regarded as an adequate proxy for the full representation of the associated Term. However, in other jurisdictions there may be a requirement to store the original text as entered or selected by the user.

Storing the Description Identifier has the added advantage if a Description is found to be wrongly associated with a particular Concept or if the associated Concept is found to have non-synonymous Descriptions. In these cases, the Description Identifier can be used to map the information to the appropriate disambiguated Concept.

8.2.2.3 Maintaining integrity following SNOMED CT releases

A SNOMED CT release may contain changes to that state of one or more Concepts or Descriptions referenced by a stored expression. The original recorded form of each stored expression should be retained as record of the information actually entered. However, it may also be useful to include updated representations that take account of changes to the referenced SNOMED CT content.

Release Format 2 files contain previous states of each component allowing comparisons to be performed. In addition, members of an appropriate Historical association reference set allow data originally recorded with a Concept that has been marked as Inactive to be mapped to an appropriate Active Concepts.

If clinical records are updated using this history information, the changes should be appended to the original representation, rather than replacing it. This ensures that any changes arising from a subsequent release can apply the improved mapping to the original Concept this can be utilised to enhance data quality.

Note: In Release Format 1, SNOMED CT Component History, Reference and Relationship tables contain information that allows data originally recorded using Inactive Concepts to be appropriately mapped to Active Concepts.

8.2.3 SNOMED CT storage options for effective retrieval

The form in which records are represented may have a substantial impact on the efficiency, accuracy and completeness of retrieval. The forms that best suit retrieval may differ from the forms that are required to meet the principles of clinically safe and legally valid electronic health records.

8.2.3.1 Storing information as entered

This option leaves information in the form entered in the electronic health record with no additions to assist future retrieval. The application must do all the work needed to locate the required records and compute subsumption and equivalence when a request is made to retrieve data.

8.2.3.2 Using an Expression Repository

An innovative approach to the issues raised by literal storage of postcoordinated expressions is to implement an expression repository. Each unique expression used in the system is stored in a referenced database table and assigned an internal unique identifier (e.g. a UUID). When an expression is used in a clinical record entry the unique expression id is used to reference the expression in the repository.

The key advantages of this approach of this approach are:

- The expression Identifier can have a fixed size whereas a postcoordinated expression in of variable and indeterminate size. This significantly improves storage and index efficiency.
- The expression repository can also be used to store normal form representations of each expression and to relate these to the original expression. This optimises performance for expression normalisation during retrieval.
• The *expression* repository could also be processed by a *Description Logic Classifier* and a *transitive closure* table of all the *expression* used in the application could then be generated. *postcoordinated* retrieval would then be highly optimised by using the *transitive closure* to test a single join between each predicate and the candidate *expressions*.

### 8.2.3.3 Minimising postcoordination

One possible approach to optimisation of retrieval is to *transform* the original stored information into an equivalent representation with the minimum number of *postcoordinated* components.

The objective of this approach is to allow the generation of simple indices for the *precoordinated* representation. It is then possible to undertake most retrievals using the *is a subtype hierarchy* to compute whether *Concepts* in the record are *subtypes* of the *Concepts* used to specify retrieval. Where *postcoordination* is required, the minimum number of additional tests are required to confirm that a *Concept* in the record meets the specified retrieval criteria.

One difficulty with this approach is that there may be more than one representation that requires the same degree of *postcoordination*. This is discussed in more detail and illustrated in *Transforming expressions to normal forms*.

If this approach is adopted additional rules need to be applied to determine the choice between alternatives with a similar number of *postcoordinated* components.

**Example:**

In the hypothetical example illustrated in *Figure 30*, the *Concept* "red steel pedal bicycle", for which no *precoordinated* representation exists, could be represented as:

"red pedal bicycle" + | make of | = | steel |

or

"steel pedal bicycle" + "colour" = "red"

Both are equally close to the objective of minimising *postcoordination*. A rule is needed to determine which of these is preferred. There is no obvious right or wrong solution to this but a simple rule that places the attributes in an *order* will, if applied consistently, allow all *postcoordinated* representations to be reduced to a single minimised form.

### Maximising postcoordination

An alternative approach is to expand any *precoordinated concepts* in the record to their fullest possible *postcoordinated* forms. This general type of *transformation* is illustrated in *Transforming expressions to normal forms*.

This approach requires a richer record structure but has the advantage that there are three possible end-points to *postcoordination*, each of which ensures that any computably equivalent representations of *Concepts* will expand to an identical *postcoordinated* form. The three end-points are summarised here:

- **Short canonical form:**
  - This is the most parsimonious of the three options.
  - A *concept* is represented as the combination of:
    - *Subtype relationships* with its most proximate *primitive* supertypes;
    - The recorded *qualifier* values and/or *defining characteristics* that distinguish it from its most proximate *primitive* supertypes.

- **Long canonical form:**
  - This option is more verbose as it includes some redundancy.
  - A *concept* is represented as the combination of:
    - *Subtype relationships* with its most proximate *primitive* supertypes;
    - All of its recorded *qualifier* values and/or *defining characteristics*, irrespective of whether they are shared by its most proximate *primitive* supertypes.
• Exhaustive postcoordinated form:
  • This option is extremely verbose.
  • A Concept is represented as a combination of:
    • Subtype relationships with all of its supertype ancestors
    • All of its recorded qualifier values and/or defining characteristics, irrespective of whether they are shared by its most proximate primitive supertypes.

If the retrieval criteria are expressed in a similar form, a relatively simple query can interrogate the record for all entries with a matching set of primitive Concepts and specified characteristics.

8.2.4 Record architectures, structures and semantics

8.2.4.1 Record structure standards and proposals

SNOMED CT is a controlled terminology that can be used in many different health record systems. The semantic model of SNOMED CT does not replace the need for a logically sound health record structure. Furthermore, the IHTSDO does not specify a particular health record structure for use in conjunction with SNOMED CT. However SNOMED CT representations of clinical concepts are intended to meet the needs of standard health record architectures for a consistent controlled coded terminology.

In particular, there is a strong interest in co-evolution of SNOMED CT and the following standards to provide a strong standard semantic foundation for future electronic health record development.

• The healthcare communication and structured document standards of HL7 (www.hl7.org). In particular:
  • The HL7 Reference Information Model and the associated development methodology;
  • Release 2 of the Clinical Document Architecture (CDA);
  • The Guide to the Use of SNOMED CT with HL7 Version 3 developed by the TermInfo Project.

• The European (CEN) Standard for Electronic Healthcare Record Communication (EN13606) (www.centc251.org).
• Continuing development and adoption of these Standards at the International level within ISO TC215.

8.2.4.2 Using SNOMED CT in standard architectures

The broad principles of the established health record architectures are based on a layered structure of components that contain and provide context to lower level components.

The container structures include some or all of the following:

• A top-level component representing the entire health record of one person.
• Intermediate layers representing information from various sources.
• A fixed transaction/composition layer at which an entry or set of entries are attributed to (and possibly signed by) an author:
  • Examples of this level include consultation notes, letters, reports, and other documents.
• Further levels that represent logical grouping within a record covering:
  • Topics, heading and categories;
  • Cluster or batteries of closely associated information.

Within the containment structures are two lower level components:

• Clinical statements:
  • A clinical statement may vary in structure to accommodate different kinds of information (e.g. patient history, clinical finding, investigation results, plans, procedures, medication and other therapies).
• Link statements:
  • Link statements state associations between clinical statements.
• Links statements can be used to specify:
  • Problem-orientated groups of record components and viewing;
  • Causal and other specified links recorded by the author of a record entry.

Each health record component has the potential to include:
• Dates and times of actual and planned events.
• Associations with people, organisations, devices and other entities that participate or are used in relations to a recorded event or plan.
• Codes or other representations that name or provide the semantic information container, link, or statement:
  • SNOMED CT fulfils this role in a structured health record.
• Additional data including text, numeric values, images and other digital data.

When SNOMED CT is used in a structured record, the links and temporal associations of components combined add further richness to the potential power of expression. This has significant advantages and is essential for many types of aggregation and decision support. However, it also adds a complicating factor that should be taken into account when designing, recording, storage, and retrieval facilities.

Example:
To retrieve and analyse the records of patients with two potentially related conditions such as "AIDS" and "Gastro-enteritis" it is not necessary for this combination to be represented in a single precoordinated or postcoordinated concept. Instead, it is possible to look for co-existence of the individual Concept "Gastro-enteritis" within the records of patients who also have "AIDS."

• The advantage of this is that there is no need for the clinician to have made the association between the two conditions. Therefore a more complete assessment of the incidence of "Gastro-enteritis" in patients with "AIDS" can be made.
• The disadvantage is that if a precoordinated or postcoordinated SNOMED CT representation of the combined concept is used, these records will not necessarily be computably equivalent to those with the two conditions recorded separately.

There is no absolute rule on when to use multiple statements associated using record structure constructs, and when to use intrinsic precoordinated or postcoordinated SNOMED CT representations. The decision maybe influences the functionality of a particular system and the specific user requirements that the system is serving. However, the following guideline is suggested:
• A combined precoordinated or postcoordinated representation is appropriate if:
  • The combined concept is a discrete recognizable Concept that differs in some way from the simple combination of the two concepts. For example:
    • | Diabetic cataract | is not the same as | Diabetes mellitus | +| Cataract | because other types of cataract may occur in the same patient;
    • | Fracture of radius and ulna | is a clinically recognizable injury, which is most effectively conveyed as a single concept.
  • Separate records for each Concept are appropriate if any of the following apply:
    • The combined Concept represents the coincidence of two potentially associated conditions or procedures;
    • The temporal and other characteristics of the two Concepts are different;
    • Where the association between the two Concepts is causal.

Example:
| Fracture of femur | caused by "fall down stairs" should be represented as separated statements linked by an appropriate record structure component. The SNOMED CT Concept "Due to" could be used to name the link between these statements.
8.2.5 Safely representing the context of recorded codes

A variety of contextual factors may affect the interpretation of statements. Contextual factors typically fall into the grey area between record structure and the semantic model. Some of these may have a profound impact on the meaning or interpretation of a statement.

This section divides this issue into four distinct categories:

- Contextual information that is not represented by SNOMED CT
- Structures that may be labelled, using SNOMED CT
- Status terms that have a profound effect on SNOMED CT encoded statements;
- Context that can safely be represented using qualifiers

8.2.5.1 Contextual information that is not represented by SNOMED CT

Clinical statements that contain SNOMED CT Concept representations will be associated with some information which is not intended to be represented using SNOMED CT:

- Dates, times of an activity of recording and activity;
- Quantitative information including ranges and durations;
- Identifiers or names of authors, providers of information or other parties involved in a recorded activity.

SNOMED CT is not intended to represent this information. Appropriate constructs in a standardised or proprietary record architecture should be used to relate this information to SNOMED CT encoded clinical statements.

8.2.5.2 Structures that may be labelled, using SNOMED CT

Clinical statements may be contained within structures that represent collections of related information. According to the nature of these structures, SNOMED CT may be used to label them. However, care should be taken to ensure that any semantic implication from such a label is clearly specified.

Many labels (such as headings within a document) may be used only to organise information for a human reader. The existence of a label such as "plan" or "family history" (even if encoded using SNOMED CT) may not necessarily affect the computer interpretation of the data within it.

Implementers should take extreme care to ensure that any semantic implication that a human reader may assume from such labels is stored on the system in a manner that allows safe interpretation. It is recommended that any apparent inherited semantic context should be represented explicitly at the individual statement level.

**Example:**

If a data element "Family history" is used and the concept | diabetes mellitus | is encoded under that heading, the statement stored in the record should encapsulate the full semantics (i.e. Family history+(Associated finding=Diabetes mellitus) using the SNOMED CT Concept Model.

Other areas in which structures might be labelled, with SNOMED CT Concepts include:

- Links between statements - SNOMED CT could be used to identify the nature of the link.

**Example:**

To indicate a presumed causal relationship.

- Indication of types (rather than identities) of people of organisations.

**Example:**

To indicate that the source of a piece of information was the patient themselves or a specified relative.

8.2.5.3 Context and Axis Modifiers

The following are examples of "axis modifiers" which may fundamentally alter the interpretation of information encoded using SNOMED CT:
Subject of information.

Example:
Stating that a relative of the patient has a particular disease. This may be recorded to state either "family history" or a social context. If the disease is represented as a SNOMED CT Concept then it must be distinguishable from a statement that patient has that disease.

Stage.

Example:
Stating that a patient should have, has been referred for, or has declined to undergo a particular procedure. These must be distinguishable from statements that a patient has had the stated procedure.

Negation and uncertainty.

Example:
Stating that a diagnosis has been excluded or is unlikely.

Contra-indication.

Example:
Related to a treatment specified using its Concept Identifier.

There is a temptation to use these modifications as though they were qualifiers. This is not a safe practise because the assumption is that a qualifier refines the meaning of the qualified Concept. A refined Concept should always be a subtype of the original concept. This is not the case for these major modifications as illustrated by the following:

- Records of a family history of Diabetes mellitus would not be expected in a response to a query for patients with a record of diabetes mellitus (and its subtypes);
- Records of "planned" + "hip replacement" should not be counted when analysing the records of patients who have had any type of "joint replacement."
- Records that state "meningitis" + "excluded" should not be counted as cases of meningitis;
- Records that state the patient is allergic to + "penicillin" are not records of treatment with an antibiotic.

This issue is discussed in more detail in the section on data entry.

The recommended approaches are:

- To ensure that the record structure captures this information in a consistent and reliable way that can be interpreted accurately when retrieving or communicating information.
- If postcoordinated SNOMED CT representations are used, the situation concept should be qualified by the finding or procedure:
  - For example, the following condition is valid family history of disorder associated finding diabetes mellitus
  - The finding or procedure must not be qualified by the situation as this would result in an expression that computed as a subtype of the clinical concept:
  - For example, the following expression is not valid diabetes mellitus qualified by family history.

8.2.5.4 Context that can safely be represented using qualifiers

Where a contextual modification can be logically regarded as a refinement of the original Concept it is reasonable to use a qualifier. Examples of this include "severity," "episodicity" and "laterality."
8.2.5.5 Concepts with built-in context

Some Concepts derived from earlier terminologies (i.e. SNOMED International and the Read Codes) contain built-in context. An example is the concept "FH: Diabetes mellitus" (FH being an abbreviation for family history). These concepts are in the Situation with explicit context hierarchy.

To the extent possible with released context attributes, these Concepts are defined (and will continue to be reviewed) so that they are computably equivalent to appropriate postcoordinated representations.

Example:

The concept "FH: Diabetes mellitus" is defined to be equivalent to the postcoordinated representation

\[ \text{"family history" + ( | associated finding | = | diabetes mellitus |)}. \]

8.3 Retrieval and Aggregation

SNOMED CT allows consistent processable representation of clinical information. SNOMED CT enabled applications should harness this capability to with practical tools for selective retrieval of information in individual clinical records. They should also support aggregation and analysis of clinical data derived from populations of records.

8.3.1 Requirements for selective retrieval

Selective retrieval is an essential function for a health record system. There are two main types of requirements:

- Retrieval of selected records from the records of members of a population of patients for one or more purposes, including the following:
  - Aggregations and analysis of data to support:
    - Epidemiological monitoring;
    - Clinical research;
    - Audit of care delivery;
    - Service planning.
  - Identification of patients with specific risk factors or other characteristics:
    - To allow specific preventative, investigative or therapeutic measures to be appropriately focused;
    - To allow further selective retrieval and analysis of the records of a subpopulation of patients;
    - To enable selection of patients for entry in a clinical trial.
- Retrieval of selected records from an individual patient record to enable:
  - Display of summary views and/or pre-completed template screens containing appropriate selected information.
    Example: Active problems/diagnoses, current medication, recent investigation results or blood pressure readings.
  - Automating responses to questions posed by a decision support protocol.
    Example: To check the record for specified symptoms, findings, investigations, procedures or diagnoses.

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36 This is not the case in the first release as the appropriate defining characteristics are not in the release set.
The following subsections address issues and requirements that are common to all types of retrieval.

8.3.1.1 Retrieval performance

The following sections identify factors that may influence performance when undertaking selective data retrieval. There are no fixed rules for optimisation of retrieval performance. Application developers should interpret the issues outlined in the guide in the light of their experience with the operating systems and data management tools that they use.

An evaluation of different approaches to retrieval was undertaken for the NHS, in connection with work on Clinical Terms Version 3 implementation. This showed that the "best" approach was not the same for all relational databases. Some software environments favour one approach while a different approach may be more effective in another environment. Therefore, it is likely that some of the factors discussed will have a significant impact on some developers, while being less relevant in others.

8.3.1.2 Retrieval quality

The quality of selective retrieval is measured in terms of two factors:

- **Completeness**: Retrieval should select all records that meet the selection criteria;
- **Specificity**: Retrieval should not select any records that do not meet the selection criteria.

The semantic structures of SNOMED CT assist application developers to achieve these goals by allowing different expressions that represent the same or similar information to be recognised and compared (see Supporting Selective Data Retrieval).

The meaning of a SNOMED CT expression may be modified by the context in which it is used. Aspects of this context are represented by:

- The record structure in which the expression is stored.
- Data directly associated with the expression in the record structure (e.g. dates and times, numeric values and units, the identity and role of the originator of the information or the performer of a procedure).
- Explicit or temporal associations with other information in the same record (e.g. co-existent conditions, likely causes of an abnormal observation, reasons for an investigation or therapeutic intervention, etc).

Storing similar information in differing structures complicates retrieval since each query must take account of alternative ways in which the required information may be stored. As a result the semantic strength of SNOMED CT may be obscured by the varied approach to structure. Therefore, realisation of the full potential benefit of SNOMED CT, requires an information model that accommodates SNOMED CT expressions and ensure consistent storage of similar information.

Another limiting factor for retrieval is the consistency and completeness of recording. The extent of use of SNOMED CT depends in part of policy and guidance at national or organisational levels, which in turn depends on requirements and priorities for data retrieval and reuse. From a technical implementation perspective a key factor in delivering consistent retrieval is a user-interface that facilitates, simplifies and encourages consistent data entry which uses SNOMED CT expressions to the extent need to meet relevant requirements.

8.3.1.3 Retrieval criteria involving record structure

Before addressing the specifics of SNOMED CT related retrieval criteria it is important to recognise that these only form one part of the picture. Most selective retrieval criteria will include a mixture of predicates, some of which apply to SNOMED CT encoded data and some of which apply to other data in the patient record. This non - SNOMED CT encoded data includes:

- Data directly related to coded clinical statements. This includes:
  - Dates and times (e.g. time of an event of finding).
  - Organisations, people or devices involved in a recorded activity or finding.
  - Temporal or causal relationships with other clinical activities or findings.
  - Quantitative values associated with SNOMED CT encoded statements.
  - Associated status and contextual information.
- Data related to the patient:
• Age and sex;
• Organisations and people responsible for care;
• Occupation, pre-existing disorders or other known risk factors.

The interplay of these factors with SNOMED CT encoded data may affect the optimum approach for data retrieval. Some non-SNOMED CT encoded retrieval criteria may significantly reduce the potential set of patients or in patient record entries that qualify for retrieval. In these cases, it may be useful to apply these criteria before testing SNOMED CT specific criteria.

Example:
• A retrieval request for the rubella vaccination status of eight-year-old girls in a family practise with average population distribution requires the review of less than 1% of the population of records.
• A retrieval request for patients who have undergone a particular procedure in the last month only needs to review record entries made in the last month.
• A retrieval request for the most recent investigation results and current medication might be more processed by initially identifying a set of recent records. Checking these records for relevant SNOMED CT values may be more efficient than applying individual queries to the entire record for each of the required items of recent information.
• A retrieval request for people with a rare clinical condition, who also have a relatively common disorder, may be more efficient if the few people with the rare condition are selected first, limiting the scope of the query for the more common condition.

These examples illustrate a general point rather than to offer guidance on the specific searches. It is important to bear in mind that the performance, completeness and specificity of retrieval are dependent on the structure of the record as well as the semantics of SNOMED CT.

8.3.2 Retrieving records containing selected concepts and their subtypes

Information in health records may be expressed at various levels of specificity.

Example:
To represent diagnoses of:
• Chest infection;
• Left lower lobe pneumonia caused by pneumococcus.

Criteria for selective retrieval may also need to be stated to different levels of detail.

Example:
To retrieve all records of
• Respiratory tract infections;
• Left lower lobe pneumonia;
• Pneumococcal pneumonia.

Occasionally a query may be designed to retrieve only record entries that include a particular general Concept. This may be useful for a quality review or to find record entries that are too general to map to a required classification.

However, in most cases, a general query should include more specific Concepts recorded in the record. For example, if the selected Concept is | Respiratory tract infection | the user would expect record entries containing Concepts such as | Chest infection | or “Left lower lobe pneumonia caused by pneumococcus” to be retrieved. The subtype hierarchy of SNOMED CT is designed to facilitate this type of retrieval. Four techniques that can be used for this purpose are outlined in the following subsections.
Note:
The subtype hierarchy is improved with new releases of SNOMED CT. These changes need to be considered if more than one version of the hierarchies is used for data analysis.

8.3.2.1 Queries expanded to identify all subtypes

A query that explicitly includes the Concept Ids of all subtype descendants of the Concept to be retrieved can be built using one of the following methods:

- A recursive tree-walk following | is a | Relationships - from the selection Concept to its subtypes and the subtypes of its subtype. Each branch of the tree walk ends on reaching a Concept with no subtypes or a Concept that is already in the set of selected Concepts.
- Using pre-generated branch number ranges associated with the selection Concept and looking up all Concepts with branch numbers in those ranges. This could be much faster than a tree-walk if Concepts are indexed by branch-number.
- Using a stored list of subtype Concept Ids for frequently queried Concepts. This would initially be generated in one of the other methods and then reused in various queries. Any stored list would need to be rebuilt after installing each release of SNOMED CT.

The resulting query may contain a large list of potential Concept Ids, but the actual query structure is simple. Therefore as long as the database engine does not restrict query size, this type of query can be run in any environment that support SQL or an SQL-like query language.

This technique is likely to be most effective when a large number of candidate record entries need to be examined and when Concept selection criteria are relatively narrow. Selecting all diagnoses using this approach would generate a predicate with tens of thousands of Concept Ids. Extremely large queries may not perform efficiently or may fail to run in some environments.

8.3.2.2 Subtype tests on each recorded concept

The Concept recorded in each candidate record entry can be tested to determine whether it is a subtype of the Concept to be retrieved. The test can be applied in one of the following ways (see also Testing and traversing subtype relationships):

- A recursive tree-walk following | is a | Relationships from the recorded Concept to its supertype and the supertypes of its supertypes. Each branch of the tree walk ends on reaching the Root Concept or a Concept that has already been visited. The test ends with a positive result if the selection Concept is encountered during the tree walk. Otherwise when all supertypes have been visited, the test ends with a negative result.
- Optimised subtype testing using techniques such as branch numbering and tree-walk enhanced with semantic-type Identifiers or hierarchy flags.

This technique is likely to be effective when the number of candidate record entries to be examined is relatively small or if the Concept selection criteria are broad. Performance is directly dependent on the time taken for each subtype test. Therefore, extensive use of this approach may only be feasible by applying one or more of the optimisations discussed in the guide.

8.3.2.3 Use a database with built in hierarchical functionality

Some databases have features which build in hierarchical functionality. These databases may support extensions to SQL that allow a predicate to be specified in a way that implies that the database schema "understands" the subtype hierarchy.

Example:

It is possible to envision a statement such as:

WHERE Record.Expression SUBTYPE-OF 414024009

If a database supports this type of predicate, it clearly simplifies the writing of SNOMED CT queries. It is also reasonable to assume that functionality of this type, built into a database engine rather than added as an afterthought, will deliver enhanced performance. However, this assumption should be tested as it depends on how appropriate the internal implementation is to subtype hierarchy of the size and complexity of SNOMED CT.
8.3.2.4 Branch-range indexing of individual records

Branch numbering is an approach to subtype testing that could be extended to index record entries. The branch numbers could be used to produce an index of all record entries stored in an application. The technique is as follows:

- Every record entry is indexed using the branch number of the Concept stored in that entry;
- The set of branch number ranges associated with the selection Concept is then used to query the branch number index.

This approach is likely to deliver high performance retrieval but it has a significant drawback. Branch numbers have to be regenerated after each SNOMED CT release and the numbering changes each time. Therefore, any indices based on branch numbers must also be rebuilt after each release, and until this rebuild is complete, this method cannot be used for retrieval. The previous set of branch numbers could be used for retrieval during the transition period but this requires a parallel set of branch numbers and branch number ranges.

The likelihood of enhanced retrieval performance should therefore be balanced against the addition of complexity to terminology updates and record maintenance.

8.3.2.5 Retrieval Based on other Relationships

While many queries will use SNOMED CT’s hierarchical subtypes to aggregate data, the attribute relationships can also be used. For example, to find all procedure concepts that use a laparoscope, search in the relationship file for Concepts with a relationship of Using Access Device: Laparoscope. Note that role hierarchies can be used to construct these queries.

8.3.3 Selective retrieval of postcoordinated expressions

The previous section deals with the retrieval of records that contain precoordinated representations of Concepts. The mechanisms and methods discussed in that section need to be extended to cover postcoordinated expressions.

The selective retrieval mechanisms applicable to postcoordinated expressions depend on the way in which this data is stored. If data is transformed to generate tables or indices that facilitate retrieval, the form of this derived data determines the type of mechanisms that can be used.

There are two significant factors in the completeness, specificity and performance:

- The structure used for representing postcoordinated expressions;
- Whether the information is only stored in the form entered of is also stored in a manner that seeks to facilitate efficient and consistent retrieval of postcoordinated expressions.

8.3.3.1 Retrieval from unrestricted relational representations of postcoordinated data

Unrestricted relational representations provide a flexible medium for storage retrieval of postcoordinated expressions. A query can be specified at any level of detail to examine the primary Concept in a statement and any or all of the associated postcoordinated qualifications, modifications, or combinations.

However, the number of joins required to specify an appropriate query may affect performance.

- Each clinical statement consists of a row in one table joined to a row in a qualifier table for each postcoordinated refinement. The clinical statement itself may have other structural relations (based on the record structure) and each patient record may consist of hundreds of thousands of statements.

The effect of this will vary according to the power and configuration of the relational database. However, some application developers may seek alternative, more limited representations to improve performance.

8.3.3.2 Retrieval from restricted postcoordinated information

An application may store data in a restricted relational representation, which limits postcoordination to a pre-specified set of qualifiers. Criteria for selection based on the values of a limited set of qualifiers require a minor extension to any of the approaches discussed in the previous section.

However, there are two significant points to note:
• When applying criteria to the values of a qualifier, any subtype of the specified value should be selected. This is similar to the consideration for the primary Concept. However, the number of tests to be performed will be more limited because:
  • Typically a qualifier value will have relatively few subtypes;
  • Only record entries that match on other criteria need to be tested.
• Some of the supported qualifying attributes may also occur in defining characteristics of some Concepts. A query that specifies the presence of a particular qualifier must not miss these cases. One way to address this issue is to ensure that when storing or transforming data for retrieval, the value of any defining characteristics that are also supported, and qualifying attributes should be copied into the qualifying value field.

8.3.3.3 Retrieval from postcoordinated data stored as parsable text or XML

Parsable text strings or XML elements are not well suited to rapid retrieval from large populations of records. However, optimisation is possible by augmenting the stored form with indexes to Concepts (e.g. indexing Concept Identifiers or range number) or by using an XML-aware database. Without such optimisation it may be possible to achieve acceptable performance for retrieval from individual records, documents or messages represented in a structured form using XML.

8.3.3.4 Retrieval of postcoordinated data stored as entered

Where postcoordinated data is only stored as entered, retrieval mechanism must do all the hard work of calculating the equivalence between statements expressed in different ways. This is possible for a small-scale search (e.g. within a single patient record) but across a large population of records it may be difficult to achieve an acceptable performance.

8.3.3.5 Retrieval from minimised postcoordinated forms

If postcoordination is minimised before storage, this allows most of the search process to be concerned with querying or testing subtype descendants.

If the query needs to specify selection criteria that cannot be expressed by a single Concept, further testing is required. Even then, if there are rules for consistently minimising postcoordination, most queries remain easy to construct and apply.

Some complex queries may present more difficulties with this approach but it remains a reasonable option for application developers concerned with minimising the overhead related to storage and retrieval while delivering reasonable performance and flexibility.

8.3.3.6 Retrieval from maximised precoordinated forms

Maximization of postcoordination offers them most flexible approach. Of the three forms suggested:

• The exhaustive form:
  • Simplifies queries since everything that is true about a Concept is stated and there is no need to check subtype descents;
  • Carries a heavy storage penalty for every record stored;
  • Requires computation of the representation of each Concept after every release.
• The long canonical form:
  • Allows queries that are relatively simple provided that a mechanism exists for checking subtype descents.
  • Although more terse than the exhaustive approach, storing this information for every record stored still has a significant storage overhead.
  • Requires rechecking or re-computing after a release, but his can be done directly from the release files by combining the | is a | relationships in the Canonical Table with the other (i.e. not " | is a | ") defining characteristics in the relationship file.
• The short canonical form:
- Requires slightly more care in construction of queries than the long canonical form;
- Requires slightly less storage than the other maximised forms;
- Like the long canonical form, can be rebuilt directly from the release tables.

8.3.4 Requirements for specific uses of selective retrieval

8.3.4.1 Specifying retrieval requirements

An application should provide a mechanism to allow users to specify retrieval requirements using SNOMED CT. This facility should allow queries to be generated that combine SNOMED CT specific selection criteria with other health record criteria.

A terminology browser that combines text searches and subtype hierarchy navigation is likely to be essential for defining SNOMED CT specific selection criteria.

Facilities for testing and traversing subtype relationships are essential for running most SNOMED CT queries that can be run against stored records. Additional functions that take account of the definitions of concepts and the refinements in expressions are needed to support more sophisticated retrieval.

8.3.4.2 Selective retrieval for reporting and analysis

Population-based retrieval and reporting is usually a task that can be run in the background or scheduled for later execution. Therefore, real - time responses are usually not essential.

The process of analysing a large number of records may take several minutes or perhaps even hours. If the application spends a little time generating an optimised query before starting to access the records, this is acceptable and may shorten overall execution time. Therefore, a technique such as query expansion may be appropriate for these tasks.

Users may also have requirements for reports on individual patients or a small group of patients. In some cases there may be an expectation of a real - time response to requests for these reports. If so, the delay while several selection criteria are expanded may be unacceptable. If the same criteria are used many times, storage of the expanded form may be a realistic option. Otherwise, an alternative retrieval technique should be considered.

8.3.4.3 Selective retrieval for decision support

Decision support tools are usually used during a consultation with a patient. Real - time response without significant delay is essential if these tools are to be used regularly and perceived as a help rather than a hindrance. A decision support algorithm may need to selectively retrieve several records to inform a single decision or piece of advice. Many of the retrieval criteria are likely to be quite general. The time taken to expand an apparently simple set of criteria so that they include all appropriate subtypes is likely to significantly impair performance. The expanded criteria could be stored in or associated with the protocol. However, the requirement to update these with new SNOMED CT releases and whenever the protocol changes add to the maintenance burden.

Since decision support protocols are primarily concerned with the records of an individual patient, it may be feasible to test all candidate records (e.g. all records that fall within a specified date range) to see if any of these are subtypes of the selection Concept(s).

Other alternatives should also be considered.

8.3.4.4 Decision support tools as authors of data in the record

As well as retrieving SNOMED CT encoded information a decision support tool may need to make entries in the record. These entries may arise directly from user interaction with a template or protocol. However, some entries made by decision support tools may record decisions made by or advice given by the tool.

8.3.4.5 Retrieving records encoded with Inactive Concepts

Records that have been encoded using Concepts that are no longer active can be retrieved by using the Historical Associations Reference Set values (i.e. "same as," "may be a," | replaced by | and "was a") in addition to | is a | subtype relationships.
An application should allow users to specify which (if any) of these Relationships or Associations should be followed when determining whether to retrieve a record entry.

- A sensible default is to treat duplicate Concepts related by the same as associations and erroneous Concepts related by replaced by Relationships as though they were interchangeable with the related Concepts.
- In the case of the ambiguous Concepts related by may be a associations the solution is less clear-cut. A choice must be made between the importance of completeness, which is best served by including these Concepts, and selectivity, which is better served by excluding them.

8.3.4.6 Retrieving and analysing legacy coded data

SNOMED CT can also be used for generated queries that examine legacy data recorded using SNOMED International, Clinical Terms Version 3 or earlier versions of the Read Codes. This can be done by using the approach outlined in strategies for data migration, to generate a query that includes all the subtypes of a selection Concept. However, the appropriate legacy codes (i.e. Read Codes, CTV3IDs or legacy SNOMED codes) are added to the query instead of the Concept Identifier.

8.4 Communicating Expressions

SNOMED CT enabled applications must support inbound and outbound communication of information that includes relevant SNOMED CT expressions. This section provides an outline of some general issues related to communication of SNOMED CT information using standard communication structures.

8.4.1 Representation of SNOMED CT information in communications

Various media exist for communicating computer processable data between applications. These include:

- Messages;
- Structured documents;
- Portable storage media (smart cards, memory cards or other similar devices);
- Application interfaces (including COM / CORBA and programmable web interfaces).

A common feature of any method of communication is the need for a formal standard (or de-facto agreed) representation of the communicated information.

To enable full communication of SNOMED CT information these agreed standards must allow the communication of precoordinated or postcoordinated representations.

Some current standards do not provide explicit support for postcoordination. Examples include:

- HL7 Version 2.x messages;
- EDIFACT implementations of European (CEN) Prestandards for laboratory communication used in the UK NHS.

In these cases, it may still be possible to include postcoordinated information by agreeing to a syntactic representation that can be used in a single message element.

Example:

Subject to message field length constraints, an expression in compositional grammar could be included in place of a simple code.

The use of this type of technique is not recommended since it may distort the intended semantics of the message, but also, and more significantly, it requires the recipient to agree to parse the code in a particular way. There is no point sending a parsable text representation of a postcoordinated Concept to recipients with no understanding of that form of representation.

More recent standards make specific provision for the support of postcoordination in representations of clinical statements. Examples include:
• HL7 Version 3, which includes the “concept description” (CD) data type which provides unlimited scope for postcoordinated modifiers;
• European (CEN) Prestandard ENV13606 for Electronic Healthcare Record Communication, which include a component name structure element, which permits postcoordination.

Communication of SNOMED CT data using explicit structures for postcoordination is strongly recommended. However, where local agreements permit, other solutions may be used. This is discussed further in the next section.

8.4.2 Overlaps between SNOMED CT and Structural Semantics

Many communication constructs have a built-in, or assumed semantic model. Example:

Rather than having a single coded expression to represent a procedure the HL7 Version 3 class Procedure contains the following coded Attributes:

• Code (cd);
• Priority (priority_cd);
• Reason (reason_cd);
• Method (method_cd);
• Procedure_site (procedure_site_cd);
• Approach_site (approach_site_cd).

Similar constructs occur in other HL7 Version 3 classes (e.g. Observation) and message standards from other sources. However, the HL7 Version 3 Procedure example shown here is probably the best example of a particular dilemma for those communicating with a message that takes some aspects of semantics to the structural level while leaving others to the coding scheme.

Suppose we want to communicate the following procedure:

• “Emergency removal of foreign body from stomach by incision”.

The HL7 Procedure class would allow this to be communicated in several different ways.

• The first option uses the postcoordinated SNOMED CT expressions and leaves the structural Attribute blank;
• The second uses the structural Attribute and does not postcoordinate the information in the expression;
• The third duplicates the same information both in the structure and in the postcoordinated expression.

These options represent the main type of approach to overlaps. However, in practise the structural model may permit similar information to be recorded in more that one way and SNOMED CT expressions also offer alternatives depending on the extent of normalisation of the representation.

The main point is to stress the potential for confusion even when using the same communication structure and the same terminology. This is not a specific problem for SNOMED CT or for a particular message design. Any combination of structural and terminological semantics is susceptible to this issue. Since effective communication of information requires both structure and terminology the challenge is to define an interface between structural and semantic models so that they form part of a common model of meaning.

8.4.3 Using Reference Sets to represent allowable value sets

Standard message specifications and communication agreements with particular user communities often specify restricted lists of codes that can be used in particular message elements:

• Examples of this include the HL7 idea of "vocabulary domains" containing "value sets" specified for use either in a general or specific context in a message element;
• The UK NHS specification for laboratory report messages, which refers to a "bounded list" of Read Codes that are to be used in particular fields of the message.

It is inevitable that a broad terminology such as SNOMED CT needs to be restricted in this way. A message element intended for representation of a | requested radiology investigation | must clearly contain a
Concept Identifier that represents a radiology procedure. The limitations may go further than this. The list of procedures that can be requested may be restricted by local convention or regulation.

A Concept Reference Set can be used to represent value sets that are permitted in a particular type of message or within a particular user community. This facilitates use of a general-purpose SNOMED CT enabled Terminology services to populate and validate the coded elements of messages.

8.4.4 SNOMED Clinical Terms and HL7

HL7 develops standards for the exchange of health related data. Most new HL7 standards developed over the last few years have been based on HL7 Version 3. The key features of HL7 Version 3 include:

- A Reference Information Model (RIM):
  - This provides a framework for the structure of communicated information.
- A formal development method:
  - This described the various steps to turn a set of requirements into appropriate models and specifications that support communication of the necessary information.
- Separation between logical models and implementation technologies:
  - Many implementations use XML but other technical approaches can be applied to implement the same models.
- Use of external codes systems and terminologies to represent concepts:
  - Model specifications include coding constraints expressed in abstract terms as Concept Domains which are implemented as Value Sets drawn from one or more code systems.

Many HL7 Version 3 models use SNOMED CT and this has led to growing demand for guidance on consistent patterns of use. In 2004, the HL7 Vocabulary Technical Committee launched the TermInfo Project to address this requirement. The project was initially conceived as having two work packages:

1. Specification of a general approach to resolving issues related to the interface between HL7 information models and terminologies or code systems;
2. A guide to use of SNOMED Clinical Terms in HL7 Version 3 communication standards.

The SNOMED CT specific package was actively supported by SNOMED International as part of a charter agreement with HL7. After several rounds of revision and review, the ‘Guide to Use of SNOMED CT in HL7 Version 3’ was accepted by HL7 as a Draft Standard for Trial Use (DSTU).

The guide itself contains both normative and informative sections. The normative sections cover:

- Guidance on dealing with specific overlaps between RIM and SNOMED CT semantics and recommendations for use of SNOMED CT in relevant Attributes of various RIM classes;
- Constraints on SNOMED CT concepts applicable to relevant Attributes in each of the major classes in the Clinical Statement pattern.

The informative sections cover:

- Examples and patterns for representing common clinical statements;
- A general discussion of the potential overlaps between an information model and a terminology model and the pros and cons of various possible approaches to their management;
- References to relevant documents and known open issues.

Following adoption the TermInfo group have encouraged in-use testing and have elicited and addressed comments on the ‘Guide to Use of SNOMED CT in HL7 Version 3’. Implemener feedback has further contributed to growing understanding of the issues and resulted in refinement of the guidance. Many of the recommendations included in the ‘Guide to Use of SNOMED CT in HL7 Version 3’ have been incorporated into domain specific HL7 Standards and national implementations.

One of the conclusions from the TermInfo group is a recognition that terminology and information models are co-dependent. They need to evolve collaboratively to meet requirements for unambiguous processable representations of information. Work with other Information Models (including EN13606 and openEHR)
indicates that the issues raised by TermInfo are not specific to SNOMED CT and HL7 (Representing clinical information using SNOMED Clinical Terms with different structural information models). Harmonisation efforts involving the IHTSDO and HL7 and other standards bodies continue to address these issues.

As part of the ongoing harmonisation work the copyright of the 'Guide to use of SNOMED CT in HL7 Version 3' is jointly held by HL7 and IHTSDO. In line with HL7 policies, the document expired as a formal HL7 DSTU after two years but it is included here in full as it continues to serve two Roles:

• A Description of the challenges of integrating an expressive terminology, such as SNOMED CT, with a rich information model;
• A pragmatic interim approach to these challenges, which allows for and anticipates the evolution of a more integrated solution.
Chapter 9

9 Change Management Guide

This part of the guide addresses requirements that arise from changes to the content, structure and use of the terminology.

The first significant change management challenge relates to migration from other coding schemes or from a less structured electronic record system. Decisions must be made about retaining or converting records, queries and protocols originally created using a terminology other than SNOMED CT.

- The initial content of this section focused on migration from SNOMED RT, SNOMED International, Clinical Terms Version 3 and the Read Codes. Some of the general points also apply to migration from other code systems.

Each release of SNOMED CT introduces some changes to content. Many of these changes are additions to breadth and depth of coverage. There may also be corrections to concept definitions and enhance the expressivity of the Concept Model.

- These changes are an essential characteristic of an evolving clinical terminology that seeks to support changing requirements. However, significant changes need to be evaluated and managed to assess and adjust for any effects they may have on the data entry and retrieval and validity and comparability of data from different sources.

Occasionally there may also be additional technical artefacts or specifications developed to meet emerging requirements.

- Additional material related to updating to support Release Format 2 has also been included and provides an example of guidance on technical changes.

As systems evolve and as the content and structure of SNOMED CT are enhanced there is a continuing requirement to manage changes smoothly and without loss of information or functionality.

- As experience grows, this guide will be further developed to address a broader range of change management issues.

9.1 Managing Content Changes in SNOMED CT

This section of the guide addresses potential issues that may affect implementations when new releases of SNOMED CT contain changes to content.

The likely impact of four general types of change are considered.

- Content additions.
- Content inactivation (e.g. inactivation of a Concept).
- Changes to relationships between concepts
- Changes to the Concept Model leading to systematic changes to a range of components.

The impact of these changes is assessed in terms of the main record service functions

- Data entry (e.g. potential requirements to change to data entry protocols).
- Data storage (e.g. whether pre-existing data needs to be migrated or processed in a particular way to ensure consistency).
- Data retrieval (e.g. whether existing queries are likely to need revising to take account of the changes).
• Communications (e.g. whether communication specification are likely to be affected and in particular potential issues from cross-version communications).

Following discussion of these general considerations, the remainder of this section holds specific advice related to any content changes in a release which are expected to require attention from implementers.

9.1.1 Changes and historical notes

9.1.1.1 EPISODICITY no longer modelled in active content

| EPISODICITY | originated in the National Health Service Clinical Terms Version 3 where it was used not to specify the first episode of a disease for a patient but rather, the first time a patient presented to their general practitioner (GP) for a particular disorder. A first episode of asthma was not intended to represent the first time a patient had asthma, but rather the first time a patient presented to their GP with asthma. | EPISODICITY | has been removed from existing concepts and is no longer used in precoordinated definitions. It can still be used in postcoordination as a qualifier.

9.1.1.2 ONSET and COURSE retired

In earlier releases, there were two attributes named | ONSET | and | COURSE |. These were retired because they could not be used reproducibly. While | ONSET | was intended to specify the rapidity of onset or the temporal pattern of presentation for a given condition, it was easily confused with the attribute | COURSE | used to represent the duration of a condition. There was not consistent agreement between observers making this distinction.

9.1.1.3 Dose form values moved

The concept 105904009 | Type of drug preparation (product) | and its subtypes were moved to the Qualifier value hierarchy as of the July 2007 release. 105904009 | Type of drug preparation (qualifier value) | better represents these concepts because they are not products.

9.1.1.4 Renaming the context/situation hierarchy

The hierarchy named 243796009 | situation with explicit context (situation) | was called | context-dependent category | until the July 2006 release. The hierarchy was renamed to better describe the meanings in this hierarchy.

9.1.1.5 Domain change for measurement/evaluation attributes

In releases prior to July 2009, six attributes were approved for use for | measurement procedure | only. For the July 2009 release, the domain for these attributes was expanded to | evaluation procedure |. See Measurement procedures and laboratory procedures on page 291 for a definition and full discussion of | evaluation procedure | and | measurement procedure |.

9.1.1.6 Move of findings to events

In January 2006, a number of concepts from the | Clinical finding | hierarchy were moved to the Event hierarchy. The attributes used to define those concepts when they were descendants of | Clinical finding | were retained after the concepts were moved to the Event hierarchy. Additional editorial policies for the use of attributes in the Event hierarchy have yet to be established.

9.2 Managing Technical Changes in SNOMED CT

This section of the guide addresses potential issues that may affect implementations when new or revised SNOMED CT technical specifications are planned or released.

Each subsection deals with a specific proposed or actual change.
9.2.1 Release Format 2 Update Guide

9.2.1.1 Introduction

9.2.1.1.1 Purpose

The purpose of RF2 is to provide a format that is flexible, unambiguous and useful. Its primary aim is to strengthen SNOMED CT by providing a format that is simple and stable, while enabling innovation through adaptations to cater for changing requirements.

This specification was developed by harmonising proposals reviewed by the IHTSDO Enhanced Release Format Project Group, including:

• The Alternate Release Format proposed by NEHTA in coordination with their Australian Affiliates.

9.2.1.1.2 Who should read this guide?

The intended audience for this guide includes technical professionals who are involved in the development and/or implementation of healthcare information systems that use SNOMED CT.

For detailed technical guidance on the existing Release Format, please consult the SNOMED CT Technical Reference Guide (TRG) and SNOMED CT Technical Implementation Guide (TIG), as well as other applicable technical documentation described in the Associated Documentation table.

For technical guidance on using Release Format 2, please consult the "SNOMED CT Release Format 2 - Reference Set Specifications" and the "SNOMED CT Release Format 2 - Data Structures Specification" documents on the Collaborative site.

9.2.1.1.3 Associated Quality Measures

Although the definition of quality measures to monitor the implementation of this standard do not fall under the scope of this guide, they will be covered by the documentation covering the QA and Release process for the Workbench.

9.2.1.1.4 Summary of Changes

The RF2 introduces a number of new concepts and capabilities. These are summarised below, and described in more detail later in this guide:

• Addition of an Identifier file to allow components to be identified by an arbitrary number of Identifiers from an arbitrary number of Identifier schemes;
• Addition of a module Identifier field to all components, enabling the source module in which each component is maintained to be identified, facilitating configuration management;
• Modified handling of the language and dialect properties of descriptions, for reduced complexity with increased utility;
• Introduction of concept enumerations making enumerations within SNOMED CT more easily extensible, self contained within the terminology (not dependent upon external documentation) and easily compatible across multiple languages;
• Addition of a Description Logic modifier concept enumeration to the Relationship file to represent different Description Logic relationship types, for example - some, all, all-some, not-some etc.

A general extensibility design pattern has also been introduced, which allows specification of a number of Reference Set formats, to meet different use cases. In RF2, reference sets:

• Result from the combination of generic Reference Set data structures, a design pattern and the application of domain constraints according to documented implementation guidelines;
• Use a machine readable model (called a Reference Set descriptor) that defines the extended information pertinent to a specific Reference Set;
• Make use of concept enumerations for representing optional information to enable machine-readability and increased extensibility;
• Apply the same history tracking and naming conventions as used elsewhere in RF2.
The RF2 enhancements all contribute to greater flexibility and more explicit and comprehensive version control than RF1, and additionally introduce new features for configuration management. As a result, RF2 is expected to accommodate evolving collaborative requirements without a need for further fundamental change in the foreseeable future. Since change to the Release Format causes difficulty and incurs cost to content developers, implementers and release centres alike, the RF2 design is expected to result in long term savings as well as improvement in product functionality and quality.

9.2.1.5 Timescales for change

It should be noted that there is a difference between the release schedule of RF1 / RF2 in official IHSTDO-supported International Releases, and the release schedule of RF1 / RF2 in Member NRC releases. It is entirely possible that RF1 will have a longer lifespan in Member NRC releases than in IHSTDO International Releases.

Actual timescales for migration of the International release to RF2 are provided under separate notices, and have not been included in this guide as they are likely to follow a different review cycle.

9.2.1.2 Principles used in the design of RF2

The following principles were used to guide modifications made to the Release Format:

- Consistent history representation across all components and across all artefacts deemed in scope of the Release Format.
- Consistent identification of all components throughout their lifecycle and clear identification of all other artefacts in scope of the Release Format.
- Consistent representation of allowable values for component characteristics.
- Consistent means of extending component data structures to meet future requirements without modification to the existing table structures.
- Consistent non-centralized means of loosely coupled Identifier assignment for components and component characteristics.
- Consistent means of representing localisations and translations for all components.
- The data structures should assist implementers to consistently implement SNOMED CT. Component data structures ideally should not have to change to accommodate changes in editorial policies.
- Ideally component data structures should be simple, generic and flexible.
- Ideally component data structures should be self-contained, removing dependence on external artefacts.
- Dependencies between components should be explicitly stated and machine-readable. For example, it should be possible to express that a reference set released as part of an extension is dependent upon version X of the Acme Extension and version Y of the SNOMED CT International Edition.
- There must be a consistent means of identifying modules and their versions --including the SNOMED CT International Release itself.
- The Release Format should minimise the total effort of meeting requirements where possible by reuse of existing data structures.
- Metadata should be machine-readable.
- Component data structures that enable software reuse are preferred over data structures that require special development of parsers.
- It should be possible to produce from a Release Format an instance of that release in the immediately prior Release Format.
- Specifications should be based on requirements derived from use cases that describe the scope and environment of their intended use.
- IHSTDO specifications should provide a common global foundation that permits the development and maintenance of SNOMED CT enabled applications that are interoperable across national and organisational boundaries.
- Changes to IHSTDO specifications should only be made if the impact on implementation is considered to be proportionate to benefit. Such changes should be recorded.
- Changes to IHSTDO specifications should be evolutionary and should deliver incremental benefits to implementers with a minimum of disruption and re-engineering.
- The SNOMED CT release format and associated guidance should facilitate a consistent implementation for known use cases.
- The specifications that support implementation of use cases should be done in a way that doesn't limit the ability to realise other use cases within the scope of SNOMED CT.
The Release Format is intended to be a distribution format and is not designed to be an implementation format. The Release Format should be designed to be consumed efficiently.

9.2.1.3 Rationale for moving from RF1 to RF2

9.2.1.3.1 Overview of Release Format 1

The current SNOMED CT release format has been in use since January 2002. During this period the generic and reusable aspects of the existing release structure have been a considerable strength.

Despite this success, there are a number of commonly accepted inconsistencies and limitations in the current SNOMED CT distribution format. This section gives a brief overview of the current SNOMED CT distribution format, and describes these limitations. For more details see the Release Format 1 - Detailed specification.

The current RF1 format is summarised in Figure 135.

![Figure 135: Release Format 1 Core Tables](image)

Each SNOMED CT concept is held as a single row in the CONCEPTS file. Each concept may have one or more descriptions associated with it. Each description is held in a single row in the Descriptions file. Each relationship, from a source concept to a destination concept, is held as a single row in the Relationships file. The type of each relationship is defined by reference to a linkage concept, also held within the CONCEPTS file.

Separate file structures are also released to provide support for maps to other terminologies and coding systems, history tracking of components and descriptions, subsets of SNOMED CT concepts and other uses.

9.2.1.3.2 Drawbacks of Release Format 1

Inconsistencies and limitations in the current Release Format have led to a desire for a new Release Format. The following list briefly outlines these issues:

- Implicit semantics that must be inferred from external documentation that is not tightly coupled to changes in the terminology itself. Changes in the interpretation of data fields are not represented in the history of the data fields themselves.
- Pervasive use of integer enumerations within data fields, rather than using the self-referential means for representing symbolic constants provided for by the SNOMED CT terminology itself.
- No consistent and clearly defined mechanism for release centres, developers, implementers, and end users to extend the RF1 data structures to meet unique and/or common needs not already provided for by the specifications and content of the SNOMED CT International Release.
- Inconsistent and unnecessarily complex data structures.
- Field overloading "where one column represents multiple attributes (i.e. state and reason for inactivation).
- Inadequate Separation of Concerns, where data representation and data usage are often conflated, resulting in a difficulty in supporting software reuse and system evolution over time.
- Inconsistent and incomplete representation of terminology history resulting in a terminology that does not meet basic principles of configuration management and control.
- Inconsistent use of both enumerated values and concepts to enumerate values.
- Inconsistent naming and field ordering.
- Term length limited to 255 bytes and to plain text format.

Release Format 2 aims to address these issues.
9.2.1.3.3 Overview of Release Format 2

Release Format 2 consists of four primary files or tables. As in the current SNOMED CT format, all files:

- are tab delimited text files;
- are UTF-8 encoded;
- contain a column header row;
- use DOS style line termination (i.e., all lines including the final line are terminated with a carriage return character followed by a line feed character).

The core table structure of RF2 is similar to that of Release Format 1, although the fields within each of the core files are different. The core files within RF2 consist of a Concept file, a Description file, and a Relationship file.

Each SNOMED CT concept is held as a single row in the Concept file. Each concept may have one or more descriptions associated with it. Each description is held in a single row in the Description file. Each relationship, from a source concept to a destination concept, is held as a single row in the Relationship file. The type of each relationship is defined by reference to a linkage concept, also held within the Concept file.

In addition to these files, an Identifier file has been added. This file holds one alternate component Identifier per row. Each alternate Identifier belongs to a particular Identifier scheme, and holds that scheme’s Identifier for the SNOMED CT Component that it references. Within a scheme, each Identifier uniquely identifies a single SNOMED CT component.

The purpose of RF2 is to provide a format that is flexible, adaptable, consistent, unambiguous and above all useful. Its primary aim is to strengthen SNOMED CT by providing a format that is simple yet flexible and powerful, allowing the format to remain constant, while allowing innovation and adaptation to changing requirements.

9.2.1.3.4 Backward compatibility

The proposed RF2 Release Format is backward compatible with the previous SNOMED CT Release Format (RF1), in the sense that all information contained within the current Release Format is represented, and legacy file formats can be derived from the new Release Formats. However, the RF2 format contains functionality which is not supportable in the previous Release Format.

In order to achieve backward compatibility, the RF2 may be transformed to create the previous distribution format. Additionally, International releases will be made available in both formats for a limited number of consecutive release cycles, for convenience. It is expected that National Release Centres will follow the same approach, and also release in dual format for a number of release cycles, unless there are specific reasons not to.

9.2.1.4 Details of Key Changes

The following subsections discuss details of the key changes between RF2 and the previous Release Format.

9.2.1.4.1 Release Format structures and the abstract model

The following tables illustrate the correspondence between the fields of Release Format 1 (RF1) and Release Format 2 (RF2). Release Format 2 fully represents the Logical Abstract Model for SNOMED CT concept and derivatives.

Release Format 1 represents a snapshot view which is less completely aligned with the logical model. As the tables illustrate all the information represented by RF1 can be fully captured in the RF2 representation. However, the reverse is not true. Therefore, some added functionality provided by RF2 cannot be provided using the RF1 data.

Table 291: Map between RF1 Concepts Table and RF2 Concept file

<table>
<thead>
<tr>
<th>RF1 Concepts Table</th>
<th>RF2 Concept File</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts. ConceptId</td>
<td>Concept.id</td>
</tr>
</tbody>
</table>
RF1 releases contain a snap-shot view of the state of each concepts at the time of release.

Concepts. ConceptStatus
- active:
  - 0 (Current);
  - 11 (Pending Move).
- Inactive:
  - All other values.

Other aspects of status represented by the Concept inactivation indicator attribute value reference set (foundation metadata concept).
- This set follows the Attribute value type reference set (foundation metadata concept).

RF1 does not support identification of separate modules.

Concepts. FullySpecifiedName
- Where Description.typeid = [Fully specified name];
- Configured by Language Reference Set
- The original FullySpecifiedName (which forms the point of reference for the meaning of the concept is the FullySpecification with the earliest effectiveTime.

Concepts. Ctv3ld
- CTV3 simple map reference set (foundation metadata concept)
- This set follows the Simple map type reference set (foundation metadata concept)

Concepts. Snomedld
- SNOMED RT identifier simple map (foundation metadata concept)
- This set follows the Simple map type reference set (foundation metadata concept)

Concepts. IsPrimitive
- 0 (fully defined);
- 1 (Primitive).

<table>
<thead>
<tr>
<th>RF1 Concepts Table</th>
<th>RF2 Concept File</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;not supported&gt;</td>
<td>Concept. effectiveTime</td>
</tr>
</tbody>
</table>

Table 292: Map between RF1 Descriptions Table and RF2 Description file

<table>
<thead>
<tr>
<th>RF1 Descriptions Table</th>
<th>RF2 Description File</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptions. DescriptionId</td>
<td>Description.id</td>
</tr>
<tr>
<td>RF1 Descriptions Table</td>
<td>RF2 Description File</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>&lt;not supported&gt;</td>
<td>Description. effectiveTime</td>
</tr>
<tr>
<td>RF1 releases contain a snap-shot view of the state of each description at the time of release.</td>
<td></td>
</tr>
</tbody>
</table>

**Descriptions. DescriptionStatus**
- **active:**
  - 0 (Current);
  - 11 (Pending Move).
- **Inactive:**
  - All other values.

**Description.active**
- 0 (Inactive);
- 1 (active).

Other aspects of status represented by the Description inactivation indicator reference set |
- This set follows the Attribute Value (reference set pattern) |

**Descriptions. DescriptionmoduleId**
<not supported>

RF1 does not support identification of separate modules.

**Descriptions. ConceptId**

**Descriptions. Term**

**Descriptions. InitialCapitalStatus**
- 0 (Initial character case insensitive);
- 1 (Case sensitive);
- <other values not supported>.

**Descriptions. caseSignificanceId**
- Initial character case insensitive |
- Case sensitive |
- Case insensitive |

**Descriptions. DescriptionType**
- **Synonym (based on RF2 naming):**
  - 0 (Not used in language /dialect):
    - RF2 - Omitted from language /dialect Refset
  - 1 (Preferred term in language /dialect):
    - RF2 - Preferred term in language /dialect Refset
  - 2 (Synonym in language /dialect):
    - RF2 - Acceptable term in language /dialect Refset
  - 3 (Fully specified name).

**Description.typeId**
- Fully specified name |
- Synonym |
- Definition |

Acceptability in language /dialect represented in Language type reference set (foundation metadata concept) for the specified language and dialect.
**RF1 Descriptions Table** | **RF2 Description File**
--- | ---
*Descriptions. LanguageCode*  
- Includes `dialect` where relevant;  
- *Language Subsets* recommended for representing preferences in `dialects`.  
*Description.languageCode*  
- `Language` only not including `dialect`  
- `Dialect` represented by a | Language type reference set (foundation metadata concept) | for the specified `language` and `dialect`.

**Table 293: Map between RF1 relationships tables and RF2 Relationship file**

<table>
<thead>
<tr>
<th><strong>RF1 Relationships Table</strong></th>
<th><strong>RF2 Relationship File</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relationships. RelationshipId</strong></td>
<td><strong>Relationship.id</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Relationship. effectiveTime</strong></td>
</tr>
</tbody>
</table>
|  | **Relationship.active**  
- 0 (Inactive);  
- 1 (active).  
Other aspects of `status` may in future be represented by the | Relationship inactivation indicator attribute value reference set (foundation metadata concept) |  
- This set follows the | Attribute value type reference set (foundation metadata concept) | |
|  | **Relationship.moduleId** |
|  | **Relationship.sourceId** |
| **Relationships. RelationshipType** | **Relationship.typeId** |
| **Relationships. ConceptId1** | **Relationship. destinationId** |
| **Relationships. CharacteristicType**  
- 0 (Defining):  
  - Inferred - in *Relationships Table*  
  - Stated - in separate *Stated Relationships Table*  
- 1 (Qualifying).  
- 2 (Historical).  
- 3 (Additional). | **Relationship. characteristicTypeId**  
- |Inferred relationship|  
- |Stated relationship|  
- |Qualifying relationship|  
- |Additional relationship|. |
9.2.1.4.2 Addition of **effectiveTime** and **active** fields

The **effectiveTime** and **active** fields enable the use of a "log style" append-only data model to track all changes to each component for full traceability. Historic data will be supplied in the **RF2 release files**, dating back to the first release in 2002.

Once released, a row in any of the **RF2 release files** will remain unchanged through future releases. In order to change certain properties of a current component (and, therefore, to create a new version of it), a new row must be added to the applicable file, containing the updated data. The **active** field in the newly added row is set to true and the timestamp in the **effectiveTime** field indicates the point in time at which the new version comes into effect.

By contrast, where editorial policy does not allow a particular property of a component to be changed whilst keeping the same **Identifier**, the component as a whole is inactivated by adding a new row containing the same data as the final valid version of the component, but with the **active** field set to false and the timestamp in the **effectiveTime** field indicating the nominal release date at which the final version ceased to be valid.

It is thus possible to see both the current values and any historical values of a component at any point in time.

9.2.1.4.3 Active field

As mentioned above, each file contains a **Boolean active** field, used to indicate whether, after the point in time specified in the **effectiveTime** field, the version of the component expressed in the row is **active** or **inactive**.

This field replaces the **status** field with a simple binary state. In the previous **Release Format**, this field was overloaded to enumerate both whether the **concept** was **active**, why it was inactivated, and whether it was about to change (or had changed) authority.

The additional information encoded in **RF1's status** enumeration is represented in **RF2** using the following **reference sets**:

- **Concept inactivation indicator**;
- **Description inactivation indicator**;
- **Relationship inactivation indicator**.

These three **reference sets** conform to the **Attribute Value reference set** pattern, and are further described in the "**SNOMED CT Release Format 2 - Reference Set Specifications**" document.

9.2.1.4.4 History tables

History tracking in **RF2**'s main files uses a log-style, append-only data model. Therefore, the separate **ComponentHistory** file that formed part of the original **Release Format** is no longer required with **RF2**.

The associations between **inactive** and **active Concepts** that are currently supported by **Historical Relationship** types (e.g. | SAME AS |, "REPLACED BY") will continue to be supported. References held in the **References table** from an **inactive component** to other equivalent or related **components** that were current in the **Release Version** in which that **component** was inactivated will also continue to be supported. However, both of these associations have now moved from the **Relationships** file and the **References** file to one of the following **Historical association** **reference sets**.
Table 294: RF1 to RF2 History Field Mappings

<table>
<thead>
<tr>
<th>RF1 source</th>
<th>RF2</th>
<th>Historical association</th>
<th>reference set</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAYBE A (in Relationships table)</td>
<td></td>
<td>POSSIBLY EQUIVALENT TO association reference set</td>
<td></td>
</tr>
<tr>
<td>Refers to (’7’ in References table)</td>
<td></td>
<td>REFERS TO concept association reference set</td>
<td></td>
</tr>
<tr>
<td>Similar to (’3’ in References table)</td>
<td></td>
<td>SIMILAR TO association reference set</td>
<td></td>
</tr>
<tr>
<td>MOVED FROM (in Relationships table) Moved from (’6’ in References table)</td>
<td></td>
<td>MOVED FROM association reference set</td>
<td></td>
</tr>
<tr>
<td>MOVED TO (in Relationships table) Moved to (’5’ in References table)</td>
<td></td>
<td>MOVED TO association reference set</td>
<td></td>
</tr>
<tr>
<td>Alternative (’4’ in References table)</td>
<td></td>
<td>ALTERNATIVE association reference set</td>
<td></td>
</tr>
<tr>
<td>WAS A (in Relationships table)</td>
<td></td>
<td>WAS A association reference set</td>
<td></td>
</tr>
<tr>
<td>REPLACED BY (in Relationships table); and Replaced by (’1’ in References table)</td>
<td></td>
<td>REPLACED BY association reference set</td>
<td></td>
</tr>
<tr>
<td>SAME AS (in Relationships table) Duplicated by (’2’ in References table)</td>
<td></td>
<td>SAME AS association reference set</td>
<td></td>
</tr>
</tbody>
</table>

These reference sets all conform to the Association reference set pattern, and are further described in the “SNOMED CT Release Format 2 - Reference Set Specifications” document.

9.2.1.4.5 Field naming

Lower camel case has been used for field names in distribution file headers and in documentation that describes these files. File names will use upper camel case (starting with a capital letter). File names have also been altered to use a singular not plural form.

An example of upper Camel Case is ThisIsUpperCamelCase. An example of Lower Camel Case is thisIsLowerCamelCase.

9.2.1.4.6 Field Ordering

Records in the Concept, Description, Relationship and Reference Set member files each start with the following four fields:

- id;
- effectiveTime
- active
- moduleId

The four fields have the following meanings:

- The id field provides a unique Identifier for the component described by the record;
- The effectiveTime gives the nominal release date at which this version of the component came into effect;
- The active flag states whether the components active or inactive;
- The moduleId identifies the source module in which the component is maintained.
The Identifier file does not follow the same format, as it works in a slightly different way to the other files, and is described in more detail in the "SNOMED CT Release Format 2 - Data Structures Specification" document.

### 9.2.1.4.7 Concept enumerations

Concept enumerations have been used across RF2 to replace integer enumerations that can only be understood by referencing external documentation. For example, in RF1, a concept status value of '4' indicates concepts that are inactive because they are ambiguous. In RF2, concept enumeration simply uses concepts in a metadata hierarchy to represent the enumerated value set rather than using arbitrary integer values directly. Using concepts to represent the enumerated values has the following advantages:

- The terminology is self contained, removing the requirement for external documents to explain the meaning of enumerated values;
- Full language handling capabilities are available for the enumerated values' representation, useful for standardised multi-lingual representation, and translation support;
- Machine readable model constructs can be used to further describe and enrich the enumerated values.

The following fields have been converted to concept enumerations:

<table>
<thead>
<tr>
<th>Table 295: RF1 to RF2 enumerated field changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File</strong></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Concept</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Relationship</td>
</tr>
</tbody>
</table>

Care should be taken not to confuse Concept Enumerations with the term "enumeration" as used in representational formats. A Concept Enumeration is a concept whose immediate children represent possible values in a range. Each possible value is represented by a single child concept, whose preferred term may be used, for example, to enable selection from a pick-list of one or more values from the range.

Mappings from RF1 values to RF2 concept enumerations are given below:

<table>
<thead>
<tr>
<th>Table 296: RF1 to RF2 enumerated value mappings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RF2 field name</strong></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>definitionStatusId</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>typeld</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>caseSignificanceld</td>
</tr>
</tbody>
</table>
### 9.2.1.4.8 Reference Set Data Structures

#### 9.2.1.4.8.1 Overview of Reference Sets

Reference Set data structures provide the foundation pieces for RF2's generic extensibility mechanism. These building blocks provide a common foundation for extension builders to extend SNOMED CT, and provide RF2 with the capability to grow with the IHTSDO's requirements over time.

Conventions applied to the RF2 files such as field naming, field ordering and history tracking have also been applied to the Reference Set specification. This has been done to provide consistency across all components in the Release Format.

Generic data structures for Reference Sets have been used to create a simple core structure that can be extended to meet a variety of requirements, rather than a complex and inextensible structure that can only be used in a finite and constrained number of ways to enforce editorial policy. This stems directly from a desire to decrease impact on the SNOMED CT community by being able to meet future requirements without having to alter the underlying data structures.

Using these generic structures, it is possible to extend the data stored within the main files of SNOMED CT to satisfy new use cases without altering the primary structure itself. Containing this extended information in externalised structures such as Reference Sets also enables terminology consumers to opt in or out of the content without burdening the primary files with the content. This prevents users from having to download all content and filter out what they don't want, and instead allows them to import the extension content should it be desired.

Reference Sets allow the SNOMED CT core data structures to be extended, allowing existing components to be grouped together into a set, each tagged with a number of additional fields. Each of these additional fields may either be another SNOMED CT component, a string or an integer. Reference set descriptors are also introduced, providing a way to identify the format and purpose of each additional field in a machine readable way. Examples of reference set data structures are provided in the "SNOMED CT Release Format 2 - Reference Set Specifications" document.

#### 9.2.1.4.8.2 RF1 Subsets Representation

The RF1 Subset mechanism consists of two tables: a Subsets table and a Subset Members table. Each row in the Subsets table describes a Subset and characteristics of that Subset, as described in the table below.

### Table 297: Subsets Table

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
</table>

---

*© 2002-2015 International Health Terminology Standards Development Organisation CVR #: 30363434*
### Table 298: Subset Members Table

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SubsetId</td>
<td>The unique SNOMED CT Identifier for this Subset</td>
</tr>
<tr>
<td>MemberId</td>
<td>The SNOMED CT Identifier of this Subset Member. This may be a Concept Identifier, Description Identifier or RelationshipId.</td>
</tr>
<tr>
<td>MemberStatus</td>
<td>An integer specifying the status, type or order of this member.</td>
</tr>
<tr>
<td>LinkedId</td>
<td>Valid for Navigation and Duplicate Terms Subsets only. For Navigation Subsets it is the SNOMED CT Identifier for a Concept that is a Navigation child of the Subset Member. For Duplicate Terms Subsets it is the SNOMED CT Identifier for the highest priority Descriptions sharing the Duplicate Term.</td>
</tr>
</tbody>
</table>

Each row in the Subset Members table sets the status of a member of an identified Subset.

Some Subsets and their members are generated automatically from an XML definition file.

9.2.1.4.8.3 Representing Subsets as Reference Sets

An existing RF1 Subset may be represented as an RF2 Reference Set in the following way:

A concept should be created in the | Reference Set | metadata hierarchy, using information in the Subset table record. A Descriptor for the Reference Set should also be set up using information in the Subset table record. Then, one Reference Set member record should be created for each Subset Member table record.

The way in which the subsets are represented in RF2 depends on the SubsetType value, as follows:
Table 299: Representing Subsets as Reference Sets

<table>
<thead>
<tr>
<th>SubsetType value</th>
<th>Description</th>
<th>Mapping to RF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Language</td>
<td>Language type Reference Set</td>
</tr>
<tr>
<td>2</td>
<td>Realm Concept</td>
<td>Ordered type Reference Set</td>
</tr>
<tr>
<td>3</td>
<td>Realm Description</td>
<td>Language type Reference Set</td>
</tr>
<tr>
<td>4</td>
<td>Realm Relationship</td>
<td>Ordered type Reference Set</td>
</tr>
<tr>
<td>5</td>
<td>Context Concept</td>
<td>Ordered type Reference Set</td>
</tr>
<tr>
<td>6</td>
<td>Context Description</td>
<td>Language type Reference Set</td>
</tr>
<tr>
<td>7</td>
<td>Navigation</td>
<td>Ordered type Reference Set</td>
</tr>
<tr>
<td>8</td>
<td>Duplicate terms</td>
<td>Ordered type Reference Set</td>
</tr>
</tbody>
</table>

9.2.1.4.8.4 Representing Subsets as Ordered type Reference Sets

| Ordered type | Reference Sets can be set up as follows:

First, set up a new concept for the Reference Set in the |Ordered type| metadata hierarchy. The position in the hierarchy should be given by the RealmId and ContextId fields in the Subset record, as follows:

SNOMED CT Model component

Foundation metadata concept

Reference set

Ordered type

RealmId

ContextId

If either the RealmId field or the ContextId fields are "0", "1", blank or null in the Subset record, then that level should not be set up in the metadata hierarchy. If a concept already exists under |Ordered type| with a matching RealmId and ContextId, then the new Reference Set should be set up in that position (as opposed to creating two |Ordered type| children with duplicate names).

First, the concept describing the Reference Set should be created with the following values:

Table 300: Reference Set Concept

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Set to</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
</tbody>
</table>
The nominal date of release for your Reference Set. If a full state valid representation of a subset's history is required, then each previous release of the Subset files must be processed in turn (by identifying Subset records with a matching SubsetOriginalId, in their SubsetVersion order), and each amended version must be applied to the reference set by appending rows in the usual fashion. The effectiveTime of each applied change should be set to the date that each version of the Subset was released.

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Set to</th>
</tr>
</thead>
<tbody>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your Reference Set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
</tbody>
</table>

Then, add up two Descriptions for the FSN and the Preferred Term of the concept:

### Table 301: Reference Set Descriptions

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Set to</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your Reference Set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>conceptId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the Reference Set that you've just added.</td>
</tr>
<tr>
<td>languageCode</td>
<td>String</td>
<td>The language of the Description. This field should be set to the language that the Subset was defined in, for example - 'en' for English.</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td>Create two Description records, one for each of the following types:</td>
</tr>
<tr>
<td>term</td>
<td>String</td>
<td>The term for the FSN should be set to the SubsetName field in the Subset record. The term for the [FSN] should be set to the same, but appended with &quot;reference set (foundation metadata concept)&quot;.</td>
</tr>
</tbody>
</table>

Finally, add one Reference Set member record for each record in the Subset Members table for the Subset:

### Table 302: Converting a Priority Subset to an Ordered Reference Set

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>How to populate</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A new unique Identifier</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>How to populate</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date on which this release was made.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>Set to the moduleId of the authoring organisation.</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>A reference to the concept describing the Reference Set you've just created.</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>Set to MemberId in the Subset Members table record.</td>
</tr>
<tr>
<td>order</td>
<td>Integer</td>
<td>Set to MemberStatus in the Subset Members table record.</td>
</tr>
</tbody>
</table>

Note: Although a Navigation Subset can be represented in an |Ordered type| reference set as described above, the values of the linkedTo field would then have a different meaning, referencing a child concept instead of grouping components together.

A Descriptor can also be set up for the Reference Set if required, as follows:

Table 303: -

<table>
<thead>
<tr>
<th>refsetld</th>
<th>referencedComponentId</th>
<th>attributeDescription</th>
<th>attributeType</th>
<th>attributeOrder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concept describing refset</td>
<td></td>
<td>component type</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Concept describing refset</td>
<td></td>
<td>Order</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concept describing refset</td>
<td></td>
<td>Linked to</td>
<td></td>
</tr>
</tbody>
</table>

Where Concept describing refset is the Concept that you’ve just set up to describe the Reference Set. The | Order | and |Linked to| concepts that describe each additional Attribute in the Reference Set can also be replaced by more descriptive ones if required. To do this, create the new concepts describing the additional fields under the | Reference set Attribute | metadata hierarchy.

9.2.1.4.8.5 Representing Subsets as Language type Reference Sets

Language type Reference Sets can be set up in a similar fashion to the above, with the following exceptions:

The LanguageCode field in the Subset record should be used to link the Reference Set's concept into the appropriate place in the | Language type| metadata sub-hierarchy. For example, a value of "en-US" in the LanguageCode field would result in the Reference Set's concept being created under |US English|:

**SNOMED CT Model component**

Foundation metadata concept

**Reference Set**

**Language type**

English

US English
RealmId
ContextId

- Where the SubsetType is "Language" and the LanguageCode is a single level (e.g. "en"), then the Reference Set should be created at the first level, under |English| in the example above;
- Where the SubsetType is "Language" and the LanguageCode is a two level (e.g. "en-US"), then the Reference Set should be created at the second level, under |US English| in the example above;
- Where the SubsetType is "Realm Description ", then the Reference Set should be created under RealmId in the example above (where RealmId is the value of the RealmId field in the Subset record);
- Where the SubsetType is "Context Description ", then the Reference Set should be created under ContextId in the example above (where ContextId is the value of the ContextId field in the Subset record and RealmId is the value of the RealmId field in the Subset record).

The Reference Set member records should be created as described in the following table:

### Table 304: Converting a Language Subset to a Language Reference Set

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>How to populate</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A new unique Identifier</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date on which this release was made.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>Set to the moduleld of the authoring organisation.</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>A reference to the concept describing the Reference Set that you've just created.</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>Set to MemberId in the Subset Members table record.</td>
</tr>
</tbody>
</table>

A Descriptor can also be set up if required.

#### 9.2.1.4.9 Metadata hierarchy

As the RF2 data structures and extensibility mechanism contain a number of concept enumerations, it is necessary to define concepts that represent these values. As well as the enumerated values, there are other machine-readable concept model structures not visible in the Release Format that require metadata (for example, the structures that define the format of a description type).

To meet this need, a new top-level hierarchy has been defined as a sibling to the | SNOMED CT Concept |, called | SNOMED CT Model component |. Note that existing metadata concepts held within the | SNOMED CT Concept | sub-hierarchy (|Linkage| and | Namespace |) will be moved to the | SNOMED CT Model component | sub-hierarchy.

The top level of the SNOMED CT Model component hierarchy is structured as follows:

- 138875005 | SNOMED CT Concept (SNOMED RT+CTV3) |
  - 900000000000441003 | SNOMED CT Model Component (metadata) |
    - 900000000000442005 | Core metadata concept (core metadata concept) |
      - (Concept enumerations required to support SNOMED CT International Release data structures)
    - 900000000000454005 | Foundation metadata concept (foundation metadata concept) |
      - (metadata required by the Reference Set extensibility mechanism)
    - 106237007 | Linkage concept (linkage concept) |...
Figure 136: SNOMED CT Model Component Hierarchy

Note that only relationships will exist between concepts in the SNOMED CT Model Component hierarchy. Other associations between concepts in this hierarchy can be modelled using an Association type reference set (foundation metadata concept) (see Association Reference Set).

9.2.1.4.10 SCTIDs and UUIDs

UUIDs are unique universal Identifiers. These 128 bit unsigned integers can be used to identify all SNOMED CT components internally.

SCTIDs will continue to be used as primary and foreign keys for concepts and descriptions, both to identify a component and to reference other components. This form is essential for vendors and implementers who will reference concepts in Clinical Information Systems and messages. SCTIDs will also be used to identify relationships. However, UUIDs will be used to identify Reference Set members.

In addition, any UUIDs used in development can also be published as additional Identifiers via the Identifier file.

9.2.1.4.11 Description text

The values permitted within the description term field have been extended to support arbitrary length content, and support mark-up content such as XHTML. The 9000000000000538005 Description format reference set allows a maximum length and format to be associated with each description type within the Description file (see Description format reference set specification).

This mechanism allows descriptive text of different formats (other than Fully Specified Names and Synonyms) to be associated with concepts, while appropriately constraining existing description types. This enables all descriptions associated with concepts that may require translation to be held in one place in the Description file.

9.2.1.4.12 LanguageCode

The languageCode field is retained in the Description file, but is restricted to contain only coarse-grained language information (e.g. "English" or "French"). Reference sets are used to indicate dialects and contexts, where required. As an example, the term "Bulldozer" would appear once in the Descriptions file with the language code en ("English"), but be listed separately in each of the Australian, UK and US English language national dialect Reference Sets as a valid term in all three dialects.

The languageCode field in RF2 is a text field and is bound to the ISO 639-1 two-character language codes.

9.2.1.4.13 Addition of a modifierId field

The underlying semantics on which SNOMED CT is based assumes that all relationships are existential restrictions. In other words, a relationship in SNOMED CT implies that there is some instance of that relationship from each instance of the source concept to any instance of the target concept. Other types of relationship, such as universal restrictions do exist and have been studied extensively. For example, the existence of a universal relationship in SNOMED CT would require that all instances of that relationship from each instance of the source concept be to an instance of the target concept.

As an example, take the following hypothetical relationship |Has child| between two concepts |Woman| and |Girl|:

| Woman | | Has child | = | Girl |

In SNOMED CT, the relationship is implicitly an existential relationship, that we can make explicit in the above syntax by adding the modifier "some:", as follows:

| Woman | some: | Has child | = | Girl |

This means that every instance of | Woman | has at least one | Has child | relationship that has as its target an instance of | Girl |. In other words, in our hypothetical world, every woman would have at least one daughter, but may also have any number of sons.
If the existential *relationship* were changed to a universal *relationship*, as follows, then the meaning would be changed:

| Woman | all: | Has child | = | Girl |

This means that, for every instance of | Woman |, all its | Has child | relationships must have a target of | Girl |. In other words, in our hypothetical world, women could only have daughters or no *children* at all, and could not have sons. This has a very different meaning from the existential *relationship* currently implied within *SNOMED CT*.

A new `modifierId` field has been added to the *Relationship file* to allow future expansion. This *concept* enumeration field will initially be set to | Some | to keep compatibility with the existing semantics of *SNOMED CT*. Widening the range of this field to include other values (such as | All |) would in future increase the expressive power of *SNOMED CT*. However, this is likely to come at the cost of an increase in reasoning complexity, leading to potential issues for classification tooling. Therefore, before extending the range of this field beyond | Some |, a test of the impact on tooling will need to be performed, and the results reviewed and approved.

**Notes:**

1. The `modifierId` field has been included at this stage as the RF2 format is likely to be stable for at least a five year period, without addition or deletion of fields. Within that period it is anticipated that other `modifierId` values will be added. Therefore, although not fully implemented at this stage, this field has been included in the initial RF2 specification as it represents an integral part of the *Description Logic* used by *SNOMED CT*.

2. Any expansion of *SNOMED CT* to include *relationships* with a `modifierId` set to a value other than | Some | will be discussed with Members first and approved by the Technical Committee.

**9.2.1.4.14 Addition of moduleId field**

A `moduleId` field has been added to help identify content and dependencies in a release. This enables release centres to compose a unified release (in a single set of *release files*) from a number of different modules, yet still identify the origin of content down to a row level within each of the releases. For example, this may be used to differentiate *SNOMED CT* International content, Australian Medicines terminology and Pathology content within the Australian *National release*. Currently this is only possible if all modules are assigned unique sub- *namespaces*, and content consumers parse *Identifier namespaces* to differentiate modules.

*Components* may move from one module to another within a particular *namespace*. Without a `moduleId`, there would be a need to retire a component in one *namespace*, and add another (with a new SCTID) to the *namespace* that the component is moved to. Additional *relationships* would also need to be set up, to link the old and new components together. None of this administrative and error-prone work is required if `moduleId`s are used.

Combining the `moduleId` with *Reference Sets* provides a powerful/versioning mechanism. The Module Dependency `reference set` (described in more detail in the *SNOMED CT Release Format 2 - Reference SetSpecifications* document) can represent interdependencies between modules and define compatible versions. This functionality can thus be used to represent version information for a terminology's components within the terminology's content itself, in a machine processable way.

The diagram below provides an example of this structure. It shows the components making up an Australian national *SNOMED CT extension* release, containing subcomponents. The links can be described using members of the Module Dependency *Reference Set*. In the example below:

- *SNOMED CT* Australian *Extension* depends upon *SNOMED CT* International 2008-01-31;
- Australian Pathology *Extension* depends upon *SNOMED CT* Australian *Extension* 2008-08-31;
- Australian Discharge Summary *Extension* depends upon *SNOMED CT* Australian *Extension* 2008-08-31.
9.2.1.4.15 Fully Specified Names and Preferred Terms

RF2, like the original Release Format, allows Fully Specified Names (FSNs) to be specified in each language using the Description file. Multiple FSNs and multiple synonyms may exist with the same languageCode for a concept. However, a particular language Reference Set will only contain a single FSN and a single preferred term for a concept.

As part of the language modifications made in the RF2, only a broad definition of a language can be made for a Description. For example, it is possible to declare a Description as English, but not US English. Also RF2 no longer contains a description type value for a “Preferred Term”, only types of | Fully Specified Name | and | Synonym |. Each Synonym can then be assigned an Acceptability value of either Acceptable or Preferred when included in a language reference set.

As a result of these changes, the preference for particular descriptions in a language or dialect is now represented using a Reference Set. This matches the specified use of Language Subsets in RF1, and deliberately removes the deprecated approach applied in some releases where preferences were derived directly from the released Descriptions file.

Language reference sets also introduce the notion of overriding or inactivating particular Descriptions that may be appropriate in one dialect, but not appropriate in another dependent dialect or context. This is achieved by allowing Descriptions that are inherited from a parent language reference set to be overridden in a child language reference set.

9.2.1.4.16 Field removals

A number of fields that appeared in the previous Release Format do not appear in RF2. These fields are listed in the table below, with an explanation of why each field has been removed and to where it has been moved. Note that where a reference set replaces a field, this reference set will be provided with the RF2 distribution.

Table 305: RF1 fields that are not use in RF2

<table>
<thead>
<tr>
<th>File</th>
<th>Field</th>
<th>Rationale for change</th>
<th>Moved to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>CTV3Id</td>
<td>To avoid cluttering the concept table.</td>
<td>Moved to the</td>
</tr>
</tbody>
</table>
9.2.1.4.17 Identifier file

The Identifier file has been added to provide a standardised means of attaching co-referent Identifiers from many different schemes to SNOMED CT components. This provides a means to:

- link UUIDs and SCTIDs, and;
- add external Identifiers such as LOINC codes, where these are truly co-referent; and;
- track history and organisational responsibility by linking old SCTIDs to new ones, where components are transferred from one name space to another, in order to allow uninterrupted use of the old SCTIDs.

This provides a mechanism for generically binding SNOMED CT components to an arbitrary number of alternative Identifiers. It is a more scalable solution than appending columns as needed to the Concept file.

Note that the Identifier file is not intended as a mapping solution. This structure is only intended to support cases where the external Identifier means exactly the same thing as the SNOMED CT component to which it is attached. For example, it is not envisioned that ICD-9, ICD-10 or CTV3 codes would be entered into this file.

The Identifier file is intended to provide a mechanism to represent external codes for SNOMED CT components where the meaning is exactly the same. For example, in the Australian Medicines terminology (AMT), concepts are "generated" from data sourced from the Therapeutic Goods Administration (TGA) and the TGA has an ARTGID for every therapeutic item. This mechanism allows the ARTGIDs to be attached directly to the corresponding AMT concept when generated. In this instance, the Identifier file assists meeting the use case without burdening the descriptions file or concepts file with this content.

9.2.1.4.18 References table

In the previous Release Format, the References Table contained References from inactive components to other equivalent or related components that were current in the Release Version in which that component was inactivated. Each Reference indicated the nature of the relationship between the inactive and persistent component.

In RF2, this information is held in Historical Association Reference Sets.

9.2.1.4.19 Textual Descriptions

In the previous Release Format, a separate Textual Descriptions file held long descriptions (of up to 512 bytes, in plain text format). In RF2, these textual descriptions are transferred to the Description file.
9.2.1.4.20 Mapping

9.2.1.4.20.1 Mapping Overview

No bespoke mapping file structures (for example, CrossMapSets tables) have been defined in RF2. Instead, the simple map Reference Set pattern and alternate map Reference Set pattern should be used, in conjunction with other Reference Set patterns, to define Reference Sets for mapping purposes. See the “SNOMED CT Release Format 2 - Reference Set Specifications” document for more details.

9.2.1.4.20.2 Mapping in RF2

RF1 CrossMaps that have a type of either one-to-one or one-to-many can be represented in RF2 as described below. The type of an RF1 CrossMap can be identified from the MapSetType field in the CrossMapSets table. The following values in the MapSetType field are possible:

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
<th>Examples</th>
<th>Mapped to RF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>One-to-one</td>
<td>ICD-O</td>
<td>Can be mapped automatically, as described below</td>
</tr>
<tr>
<td>2</td>
<td>One-to-many</td>
<td>ICD-9-CM</td>
<td>Can be mapped automatically, as described below</td>
</tr>
<tr>
<td>3</td>
<td>Alternate on-to-one maps</td>
<td>None known of</td>
<td>Can be mapped automatically. Further definition will be given if necessary.</td>
</tr>
<tr>
<td>4</td>
<td>Alternate one-to-many</td>
<td>None known of</td>
<td>May need manual intervention to map.</td>
</tr>
</tbody>
</table>

For CrossMaps that have a MapSetType of either ‘1’ or ‘2’, first, create a concept under the |Complex map| sub-hierarchy to describe the Complex map Reference Set, in the following location:

SNOMED CT Model component

Foundation metadata concept

Reference Set

Complex map

MapSetRealmId

Where MapSetRealmId is set to the contents of the MapSetRealmId field in the CrossMapsSets record of the CrossMap to be represented in RF2 format. Where the MapSetRealmId field is blank or null, then an intermediate concept should not be created, and the Map Reference Set concept should be created as a direct child of |Complex map|. The concept should be created as follows:

Table 307: RF2 Map Versioning

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Set to</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your Map Reference set. The year of the nominal release should tie up with the year in the MapSetSchemeVersion field in the CrossMapSets record.</td>
</tr>
</tbody>
</table>
Once the concept is created, add two Descriptions for the FSN and a Synonym.

Table 308: RF2 Mapping Metadata

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Set to</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>SCTID</td>
<td>A unique id in your namespace.</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release for your reference set.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleId</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>conceptId</td>
<td>SCTID</td>
<td>The Identifier of the concept describing the Reference Set that you've just added.</td>
</tr>
<tr>
<td>languageCode</td>
<td>String</td>
<td>The language of the Description.</td>
</tr>
<tr>
<td>typeId</td>
<td>SCTID</td>
<td>Create two descriptions, with each of the following types:</td>
</tr>
<tr>
<td>term</td>
<td>String</td>
<td>Terms for the FSN and the Synonym. The Synonym should be set to the MapSetName in the CrossMapSets record. The FSN should be set to: MapSetName + &quot;(&quot;+MapSetSchemeId + &quot;)&quot; + &quot; reference set (foundation metadata concept)&quot;.</td>
</tr>
</tbody>
</table>

Finally, add members to the Reference Set that you've just created.

To do this, identify each CrossMaps table record with a MapSetId that matches the MapSetId field in the CrossMapsSets record for the CrossMap that you're representing in RF2. For each CrossMap table record, identify the related CrossMapTarget record using the MapTargetId field in the CrossMaps record. The TargetCodes field in the CrossMapTarget record will contain zero or more target codes, each separated by a separator character identified by the MapSetSeparator field of the CrossMapSets record.

One Reference Set member record should be created for each target code identified within the TargetCodes field, as follows:

Table 309: RF2 Mapping Representation

<table>
<thead>
<tr>
<th>Field</th>
<th>Data type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>UUID</td>
<td>A unique UUID for the new member record.</td>
</tr>
<tr>
<td>Field</td>
<td>Data type</td>
<td>Purpose</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>effectiveTime</td>
<td>Time</td>
<td>The nominal date of release that this member is to be first introduced in.</td>
</tr>
<tr>
<td>active</td>
<td>Boolean</td>
<td>'1'</td>
</tr>
<tr>
<td>moduleld</td>
<td>SCTID</td>
<td>The module Identifier for your authoring organisation.</td>
</tr>
<tr>
<td>refsetld</td>
<td>SCTID</td>
<td>The id of the concept that describes the Reference Set that you've just created.</td>
</tr>
<tr>
<td>referencedComponentId</td>
<td>SCTID</td>
<td>Set to the MapConceptId in the CrossMaps record.</td>
</tr>
<tr>
<td>mapGroup</td>
<td>Integer</td>
<td>This field should be set to '1' for the first target code within TargetCodes field of the CrossMapTargets record. If there is more than one target code in the field (separated by a separator character), then this field should be set to '2', '3', etc. For each subsequent code.</td>
</tr>
<tr>
<td>mapPriority</td>
<td>Integer</td>
<td>'1'</td>
</tr>
<tr>
<td>mapRule</td>
<td>String</td>
<td>Set to null</td>
</tr>
<tr>
<td>mapAdvice</td>
<td>String</td>
<td>Set to null</td>
</tr>
<tr>
<td>mapTarget</td>
<td>String</td>
<td>Set to the target code in the TargetCodes field of the CrossMapTargets record.</td>
</tr>
</tbody>
</table>

### 9.2.1.4.21 Release Types

Release Format 1 only supports a single Release Type which represented the entire set of currently relevant components. In contrast Release Format 2 supports three different Release Types including a full historical view of all components ever released and a delta release that contains only the changes from one release to another.

The Release Format 2 Specification describes the Release types and the Terminology Services Guide (7) provides advice on importing different Release types.

### 9.2.1.4.22 Interchange format

RF2 is conceived as a replacement for the current Release Format. It is designed to provide a way to publish releases of SNOMED CT Release to implementers and other licensees. There is a close relationship between the requirements to support distribution of content and the requirements for exchanging components during content development. However, there are also significant differences related to the requirement for additional development information (author, change time, etc) and a need to support work with ‘interim’ incomplete and unpublished components which have not yet been assigned a SNOMED CT identifier.

Previous IHTSDO work resulted in a draft specification of SNOMED Interchange Format (SIF) which addressed some of these issues. Some of the provisions of RF2 are already supported by SIF but others will require revisions to the SIF specification.

### 9.2.1.4.23 Post Coordinated expression Syntax

RF2 allows relationship types to be extended from “existential qualification” to other types of relationship such as “universal qualification”. This extension will not be used in initial releases until the complexity of the underlying semantics has been fully tested, but once it is introduced, post coordinated expression syntax will also need to be extended to cater for this.
9.2.1.5 RF1 Compatibility and Conversion Tools

In January 2012 the IHTSDO switched from the original Release Format (used for SNOMED CT distribution since 2002), to the more flexible and consistent Release Format 2 (RF2). This means that from that date onward the primary source data for the SNOMED CT International Release is maintained and distributed in the RF2 format.

The IHTSDO recognises that, while implementers will wish to benefit from the features of the new format, there is inevitably a transitional period during which both format are in use. Therefore, the IHTSDO provides the following resources to support users whose system do not yet support SNOMED CT Release Format 2:

- **Release Format 1** files will continue to be included in the International Release for a limited period
  
  - These files are not the authoritative version of SNOMED CT but are generated from the authoritative RF2 data using a software utility developed for this purpose.
  
  - The resulting RF1 data retains the functionality of the original release data but does not support any of the features of RF2. While all the clinically relevant SNOMED CT hierarchies are identical in both releases, the additional "Metadata Hierarchy" added as part of the RF2 upgrade is not included in the RF1 converted data. In addition there are some cases where Identifiers of RF1 derivatives (Subsets and Cross Maps) differ from those used for the equivalent Reference Sets in RF2. These differences are an essential consequence of ensuring that the RF1 data produced by conversion from RF2 is fully compatibility with existing RF1 systems.

- The RF2 to RF1 Conversion Tool used for generating the RF1 files is also available to all IHTSDO Members and Affiliate Licensees
  
  - The "RF2 Conversion Tool" is an open source, Java-based, software tool to facilitate the conversion of SNOMED CT files released in RF2 format into RF1 format. The tool provides both a command line utility and a Graphical User Interface (GUI) to facilitate configuration, progress tracking and the maintenance of additional data whenever it is not available as part of an RF2 release.
  
  - The limitations of RF2 to RF1 conversion (noted above) will also apply to conversion undertaken using this tool. To enable the conversion to be completed successfully in a way that retains and replaces Identifiers consistently for the RF1 environment a set of auxiliary files (the "RF1 Compatibility Package") is also required.

The "RF2 to RF1 Conversion Tool" and the "RF1 Compatibility Package" are available for IHTSDO Members and Affiliates to download in the same way as the SNOMED CT International Release.

**Caution:**

These resources and tools are intended for use during a transitional period and should not be considered as a long term alternative to migration to support direct use of RF2 data within applications. As SNOMED CT continues to evolve more of the specific feature of RF2 will be used to add value to the terminology. Some of the added value delivered by RF2 is soon likely to be regarded as essential for effective solutions to user requirements.

9.2.1.5.1 Relationship Refinability Reference Set

The Relationship Refinability Reference Set is included in the RF1 Compatibility Pack. It provides information about whether it is permissible to refine the value of a Relationship. This information is equivalent to the Release Format 1 Relationships. refinability field. It is not included in the main RF2 release as it value is likely to diminish over time as the Machine Readable Concept Model provides a more complete representation of refinability.

This Reference Set is identified as 900000000000488004 | Relationship refinability attribute value reference set (foundation metadata concept) | and its Concept enumeration values are specified in Table 310.
### Table 310: Refinability value (foundation metadata concept) (9000000000000226000)

<table>
<thead>
<tr>
<th>Id</th>
<th>Term</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000007000</td>
<td></td>
<td>Not refinable (foundation metadata concept)</td>
</tr>
<tr>
<td>9000000000000218008</td>
<td></td>
<td>Mandatory refinability (foundation metadata concept)</td>
</tr>
<tr>
<td>9000000000000216007</td>
<td></td>
<td>Optional refinability (foundation metadata concept)</td>
</tr>
</tbody>
</table>

### 9.2.2 SNOMED CT identifier Update Notes

These notes provide update guidance on a change to the management and usage of SNOMED CT identifiers agreed during 2011. The resulting changes to specifications and associated implementation guidance have been incorporated within the relevant sections of the Technical Implementation Guide from 2012-01-31.

The change described by this note is designed to remove the need for changing SNOMED CT Identifiers when transferring responsibility for maintenance and distribution of a SNOMED CT component from an Extension to the International Release, while maintaining an effective track of the origin and maintenance responsibilities for each component.

In addition, the change also remove the need for changing SNOMED CT Identifiers when transferring responsibility for maintenance and distribution of a SNOMED CT component from an Extension to an Extension that is a formally recognised hierarchical-ancestor of the originating Extension.

### Rationale for the Change

SNOMED CT identifiers are unique integer Identifiers which include embedded information about the type and origin of the components they identify. One part of this embedded information is the namespace-identifier which identifies the Extension in which the component originated.

Prior to the change described by this note the namespace-identifier also determined the organisation responsible for maintaining the component. As a consequence, the specifications required that whenever responsibility for maintenance of component was transferred this required it to be inactivated and replaced by a new component with a new SCTID with a partition identifier and namespace-Identifier appropriated to the new maintenance arrangement.

The Identifier change resulting from moving a component from an Extension to the International Release causes disruption in the authoring environment. From an implementation perspective several SNOMED CT identifiers changed from one release to the next, without any change in intended meaning, as a result of adoption of concept from an Extension as part of the International Release. These changes had a negative impact on system operation and interoperability between systems.

### Description of the Change

The namespace-identifier continues to identify the Extension in which the component originated. However, it no longer implies a permanent immutable responsibility for maintenance. Instead, within specified limits and with agreement between the responsible organisations, the maintenance responsibility may be reassigned without issuing a new Identifier.

The permitted reassignments of responsibility are limited to ensure that the organisation responsible for maintaining a component can be determined. Thus the end result of any transfer of responsibility must result in the component being maintained by one of the organisation responsible for one of the following:
• the Extension namespace specified by the namespace-identifier of its Identifier;
• an Extension with a namespace-identifier that is a hierarchical ancestor of the namespace-identifier of the originating Extension;
• the International Release.

The values of the of the partition-identifier which previously indicated that a component was part of an Extension, continue to indicate that the SCTID contains a namespace-identifier. However, some components with a namespace-identifier may now be maintained as part of the International Release. Therefore, for clarity, the definition of partition-identifier has been revised to indicate that the values determine whether the SCTID conforms to the long format (with a namespace-identifier) or the short format (without a namespace), whereas an Extension owner must issue a long format SCTIDs (including a namespace-identifier that is registered as belonging to them).

The moduleId field, introduced in Release Format 2 and held against each component, records the organisation currently responsible for maintaining the component. The moduleId must refer to a module delivered by the organisation maintaining the component and the namespace-identifier of this moduleId must belong to the maintaining organisation.

Following the change, migration of components between Extensions would be possible without a change to their SCTIDs, according to the following rules:

• A component can be moved from any Extension to the International Release without a change to its SCTID.
• A component can be moved from an Extension to a parent or ancestor Extension without a change to its SCTID.
• A component can be moved from the International Release back to its originating Extension without a change to its SCTID.

In all other cases, the existing rules for moving components between Extensions should be used. These require a change of SCTID to occur with tracking of inactivation in the appropriate Component Inactivation Reference Set and cross-references created in the appropriate Historical Association Reference Set (or as historical relationships in Release Format 1).

**Caution:** Components that originated in the International Release must not be moved to any Extension without a change to the SCTID.

In order to make explicit which Extensions are parents of which other Extensions, concepts under the Namespace Concept may now be rearranged as a nested hierarchy of namespaces. All namespaces at the top level of this hierarchy are considered to have as their parent the International Release. The Namespace Concept for an Extension that is dependent on another Extension may be nested as a child (sub-type) of the Namespace Concept for the Extension on which it depends.

**Caution:** Components that originated in an Extension must not be moved to any other Extension unless the Namespace Concept associated with the target Extension is an ancestor of Namespace Concept associated with source Extension. The ancestry of Namespace Concepts is determined by the subtype hierarchy distributed as part of the International Release. Other moves between Extensions require a change of SCTID.

Guidance has been developed for producers and consumers of SCTIDs, to help avoid conflicts of ownership and to facilitate identification of owning organisations (see Guidance for Producers of SNOMED CT Identifiers and Guidance for Consumers of SNOMED CT Identifiers).

**Benefits of the Change**

The key benefits of making this change are:

• Large scale retirement and replacement of SCTIDs place an increased maintenance burden on implementers with no perceivable benefit. This change significantly reduces that burden.
• The change maintains the distinction of the namespace and module Identifiers - the former for the creators of content and the latter for the maintainers.
• The change eases the burdens of content providers in the chain of submissions to National Extension and the IHTSDO in detecting their content in public releases. It enables them to set policies on how to detect and manage content migration.
• Long term contributions will come from existing Extensions. This change will reduce impact on both the National Release Centre Extension managers and the source providers.
• The change removes the disincentive to migrate content to the International release or to a parent Extension.
• It will enable more frequent incremental release of content due to decreased migration burden.

9.3 Migrating Existing Data

The transition to SNOMED CT from legacy code systems requires several changes. Many of the most important changes relate to organisation and user training, which are outside the scope of this technical guide.

From the technical perspective, there are two principal migration issues.
• Maintenance of the integrity and value of pre-existing data recorded using other coding schemes (legacy data).
• Maintenance and development of the functionality delivered by software applications that use queries and protocols that include or refer to codes in other coding schemes (legacy queries and protocols).

9.3.1 Intended audience

The intended audience for this section is individuals or any organisations that wish to develop and deploy systems that use SNOMED CT but who currently have existing data represented using other coding schemes. This section is therefore contains information that is relevant to various people including:

• Clinical software developers, including those who have worked with a version of the Clinical Terms (the Read Codes) or with SNOMED CT terminologies;
• Clinicians, whose patient data has been stored in non-SNOMED CT systems and who rely on reports and decision support from these systems;
• Healthcare planners, managers and information specialists who rely on the secondary use of coded clinical information.

9.3.2 Migration requirements

Migration is required to enable information originally recorded prior to introduction of SNOMED CT to be retrieved and reused within a SNOMED CT enabled application.

Types of information that need to be considered as part of the migration process include:
• Coded data stored in existing systems.
• Information systems, e.g. software and hardware.
• Decision support protocols.
• Data entry templates.
• Queries and other data retrieval, aggregation and analysis specifications.

9.3.3 Strategies for migration

Moving from a legacy coding scheme to SNOMED CT requires attention to be paid to continued accessibility and use of data encoded using the legacy scheme.

The following general approaches may be applied or adapted taking accounts of the capability of the SNOMED CT enabled application and the value and relevance of existing data.
• Mapping or converting the data:

---

37 A “Legacy code system” is code system used prior to implementation of SNOMED CT.
This requires each instance of a code in the existing data to be mapped to an appropriate \textit{SNOMED CT expression}. This \textit{expression} is then associated with the existing coded record entry as part of a record entry that conforms to the information model used in the \textit{SNOMED CT enabled application}.

- **Linking or integrating existing data:**
  - The existing data is retained in its native form or in an intermediate form. However, the \textit{SNOMED CT enabled application} is designed (or adapted) to access this existing information as if it had been converted. To deliver this functionality, queries and/or data are in effect mapped at the time of retrieval, rather than at the time of upgrading the system. This can be achieved in different ways some of which involve direct use of mapping tables and others in which, while the existing data is unchanged, an index derived from a map to \textit{SNOMED CT} is generated to optimise subsequent access.

- **Archive or retain old data in its original form, and where it is necessary to retrieve historical information,** use \textit{components} from the legacy system to do this:
  - This approach completely separates the new \textit{SNOMED CT} from the legacy data and is unlikely to be acceptable in clinical practise. However, it may be appropriate for some data warehousing applications where the wholesale conversion of data is considered too onerous.

### 9.3.4 General considerations for data migration

A substantial body of clinical information resides in electronic systems, represented using existing coding schemes, terminologies and classifications. This information may be of value to individual patient records or to population aggregations. Similarly, there are many queries and decision support protocols that contain knowledge representation based on existing terminologies. The volume and heterogeneous nature the existing data means different approaches may be required to meet specific sets of requirements.

Factors that need to be considered include:

- **The volume and value of existing in the context of the anticipated uses of a future \textit{SNOMED CT application}:**
  - The scale of the task and the potential value of migrated data are interrelated. Relatively small amounts of data that are of debatable value to a future system may not justify an elaborate migration process. On the other hand, it is vital to ensure that valuable existing data remains fully accessible within a \textit{SNOMED CT enabled application}.

  \textbf{Example}: In the UK alone, there are over 50 million patients primary care electronic records coded using one of the versions of the \textit{Read Codes}. Based on typical patterns of use this means there are several billion coded record entries that may need to be taken into account in the migration process. A substantial proportion of this data has continuing clinical value and thus despite the scale of the task it is important to ensure that data is migrated accurately and efficiently.

- **Data quality and consistency:**
  - Different users in different settings may select codes and terms in idiosyncratic ways to reflect their needs. This may be acceptable locally but it creates an obstacle to migration if the goal is consistent and comparable information at a regional, national or global level.

- **Different source code systems:**
  - Several different coding scheme versions are in use and each of these poses specific challenges and offers a different profile of potential benefits.

- **Different information systems:**
  - There are many system suppliers. As a result of system development and commercial mergers and takeovers, many suppliers support more than one application in the same domain. The challenge is to migrate from this diverse situation to a next generation environment supporting standards such as \textit{SNOMED CT}.

- **Different information models:**
In addition to differences in the use of codes, existing systems inevitably have a variety of approaches to structuring clinical information. As a result, the process of migrating data between systems is not simply a question of converting codes. The underlying architecture of the source data also needs to be taken into account to make optimal use of existing data without losing processable information or introducing errors.

9.3.5 Specific data migration issues

9.3.5.1 Retaining existing coded data

Migration does not mean over-writing legacy coded data with SNOMED CT expression. This is strongly discouraged and users are advised to ensure that data stored at the time of data entry is preserved. This is essential for two main reasons:

- Medico-legal status of an altered clinical record may become degraded;
- The original record may be an invaluable resource, should migration produce unexpected results.

9.3.5.2 Hierarchies and Identifiers

The use and representation of hierarchies in SNOMED CT differs from the approach taken in many older code systems and classifications. This has a number of consequences that may affect the migration of queries, decision support protocols and data entry templates.

- Meaningless Identifiers:
  - The codes specified in ICD-9, ICD-10, the Read Codes and SNOMED International provide information about where the code is located in a hierarchy. This allowed simple pattern matching queries to be used for some types of retrieval.

  **Example:** In SNOMED International, all 'diagnoses related to the digestive system' can be retrieved by a query for all codes starting with 'D5'.

  The Identifier of a SNOMED CT concept does not provide any information about the way it relates to other concepts. Therefore, a simple pattern matching query cannot be used to retrieve related information represented using SNOMED CT. Instead, the query that specifies a subtype of the required concept is evaluated by testing the transitive closure of the set of subtype Relationships.

  **Example:** All 'diagnoses related to the digestive system' can be retrieved by a query for expressions that are subtypes of 119292006 | disorder of gastrointestinal tract |.

- Polyhierarchy:

  - Statistical classifications and many other code systems have a monohierarchy in which each code falls within only one branch of the hierarchy. In contrast, the SNOMED CT subtype hierarchy is a polyhierarchy, which means that each concepts can by a subtype of many different concepts. This is a powerful feature of SNOMED CT but it may significantly alter the results of a migrated from an earlier scheme.

  **Example:** All 'diagnoses related to the digestive system' is some schemes may exclude codes that are primarily classified as infective disorders even they affect the digestive system. However, a SNOMED CT query includes all subtype concepts regardless of whether they are also in another hierarchy.

- Different hierarchies:

  - Hierarchies in different code systems may be based on different principles and as a result queries that are migrated to SNOMED CT may return unexpected results. This may also relate to different interpretation of apparently identical concepts.

  **Example:** Should a query for the concept 'nephrectomy' return only patients who have had a total nephrectomy or should the results include those with a record of a partial nephrectomy? If the partial nephrectomies are to be included then how much kidney tissue must be removed...
to count as a nephrectomy? If the partial nephrectomies are not included then should a record entry including the concept 'nephrectomy' (without specifying partial or total) be included? The SNOMED CT subtype hierarchy determines the answer to these questions based on the defining Relationships. The query may need to be refined to meet more specific expectations.

9.3.5.3 postcoordination

SNOMED CT, enables the use of postcoordinated expressions to represent detailed clinical information (such as observations or procedures) by reference to multiple Concept Identifiers.

When considering migration of existing data an important question is whether postcoordination is required to replace existing coded data. The answer to this question depends on the specificity and expressivity of the existing coding scheme.

There are four situations in which postcoordination may be required or useful in the mapping process.

• To capture data postcoordinated in the original coding scheme:
  • The extent to which this data can be mapped to SNOMED CT depends on the consistency of the original representation and the degree of alignment with the SNOMED CT Concept Model. Refinements in the source data are not sanctioned by the Concept Model may be mapped to similar approved Attributes or downgraded to text. Alternatively, they may be retained as expressions that fall outside the scope of Concept Model although this may limit effective retrieval.
  
  Example: Information coded using NHS Clinical Terms Version 3, may also include postcoordination using qualifiers. In most cases, these qualifiers can be represented using postcoordinated expressions.

• To represent information which the originating coding system precoordinates but which SNOMED CT can only represent using a postcoordinated expression.
  
  Example: A specialised radiology coding systems may have separate codes for the same procedure applied to different body sites. If SNOMED CT does not include these, they can be represented using postcoordinated expressions with 'procedure site' and 'laterality' Attributes applied.

• To incorporate additional information which the originating clinical system represents in a consistent proprietary form.
  
  Example: A system may have a separate field for laterality and this can be applied during the mapping process to generate a postcoordinated expression.

• To satisfy a preference for a consistent postcoordinated representation of a particular type of data.
  
  Example: There may be a preference to always represent allergies by postcoordinating the substance, rather than using one of the precoordinated 'allergic to x' concepts.

9.3.6 Migration from earlier SNOMED CT code systems

This section contains specific advice related to migration to SNOMED CT from previous SNOMED CT code systems including SNOMED RT and SNOMED International.

9.3.6.1 Migration from SNOMED RT

Migration from SNOMED RT poses very few significant issues, since many features of the design of SNOMED CT including the use of SCTIDs were incorporated into SNOMED RT.

The transition to SNOMED CT for users of SNOMED RT is relatively straightforward because the Concept Identifiers of SNOMED RT are for the most part the same as those used in SNOMED CT. In some cases, during the merger of SNOMED RT and Clinical Terms Version 3 some Concepts in SNOMED RT have been found to be ambiguous or duplicated. These Concepts have been inactivated by an appropriate
change of status and adding a record in the Component Inactivation Reference Sets, but are still present in the Concepts Table and are linked to Active Concepts by the Historical Associations Reference Set:

- Each duplicate Concept has a | SAME AS | Association to the Active Concept with the same meaning as the duplicate Concept;
- Each ambiguous Concept has | MAY BE A | Association to one or more Active Concepts, which represent possible disambiguated meanings.

These Associations can be used either to allow Concepts recorded using these Concepts to be recognised by retrieval tools or to enable mapping of the stored information to the appropriate active Concept Identifier. If any stored Concept Identifier of an Inactive Concept is mapped to an active Concept Identifier using these Associations it is strongly recommended that the original Concept Identifier is also retained. This enables future improvements or corrections of such mappings if revised Associations are present in a future release of SNOMED CT.

In addition, SNOMED RT contained both generic and brand name drugs for the US. A decision was made during the merger process to not retire these concepts using the extension mechanisms, but to place these components directly in the US Drug Extension. Therefore to access all SNOMED RT components you will need to use the US Drug Extension in addition to the SNOMED CT International Release.

Like SNOMED CT, SNOMED RT also contains the appropriate legacy SNOMEDID from SNOMED International.

9.3.6.2 Migration from SNOMED International

The meaning of coded clinical data encoded using SNOMED International is maintained using SNOMED CT mechanisms that support concept permanence and version control. Even when a Concept is retired from active use its code is never reassigned to another Concept. Concept permanence ensures that codes assigned in SNOMED International are retained, accessible, and not reused. The codes used in SNOMED International are present in SNOMED CT in the 900000000000498005 | SNOMED RT ID simple map reference set | which links the old alphanumeric codes to the SNOMED CT concept identifiers. For further information see the specification of Simple map reference sets.

The 900000000000498005 | SNOMED RT ID simple map reference set | can be used either to allow recognition of legacy data by SNOMED CT retrieval tools or to enable mapping of the codes and storage of the appropriate Concept Identifier.

9.3.6.3 Migration from SNOMED 2 and SNOP

For information on migration from SNOMED International (SNOMED 3 to 3.5) see Migration from SNOMED International.

To assist in the migration of legacy data from SNOMED II (1979) and SNOP (1965), a “Bridge File” (mapping table) is available which links each legacy code to its corresponding code in the first release of SNOMED CT (note these are same identifier as in SNOMED RT).

The bridge file is included in the SNOMED CT International Release distribution. The file are locating the following subdirectory:

- SnomedCT_Release_INT_[YYYYMMDD]\RF1Release\OtherResources\BridgeFiles.

The file for mapping from SNOMED 2 is in the zip archive:

zres_BridgeFile_Snomed2ToSnomedRT_INT_20020131.zip

- File name: SNO2-SRT10_Bridge.txt
- This is a tab delimited file with column headings
- Column 1: CODE is the SNOMED code
- Column 4: ConceptId is the SNOMED CT Concept identifier
- (note that the target ConceptId in SNOMED RT are the same as the identifiers in SNOMED CT)
9.3.7 Migration from Read Codes and CTV3

Read Codes and Clinical Terms Version 3 codes are present in SNOMED CT in the 900000000000497000 | CTV3 simple map reference set | which links the old alphanumeric codes to the SNOMED CT concept identifiers. For further information see the specification of Simple map reference sets.

The 900000000000497000 | CTV3 simple map reference set | can be used either to allow recognition of legacy data by SNOMED CT retrieval tools or to enable mapping of the codes and storage of the appropriate Concept Identifier.

Attention: Organisations based in the UK that are planning to migrate from NHS Clinical Terms Version 3 or earlier versions of the Read Codes are advised to review the documentation and mapping tables published by the UK NHS. These resources support more sophisticated mapping based on use of terms and patterns of use that meet UK requirements. Separate advisory documents and tables for each of the Read Code versions are available as part of the NHS Terminology Reference Data Update Distribution Service (TRUD) https://www.uktcregistration.nss.cfth.nhs.uk/trud/. These materials are updated with each SNOMED CT UK Extension Release.
10 Extension Services Guide

This part of the guide describes additional services which some advanced users or implementers may require to allow them to create or maintain Extensions for use in a particular country, organisation or specialty.

The most common of these requirements will be to support the creation and maintenance of specialised Reference sets. Uses for Reference Sets include representation of value sets, marking descriptions to indicate acceptability of terms in a specific language or specialty, alternative hierarchies, maps to classifications and annotations.

10.1 Rationale for Extensions

The SNOMED CT Extension mechanism allows authorised organisations to add locally valid components and Reference Sets without compromising the SNOMED CT International Edition. This facility will be valuable to:

- Meet the needs of specialties and realms;
- Meet vendor needs;
- Meet local business needs.

10.2 Extension Namespaces and SNOMED CT identifiers

The components of an extension have identifiers (SCTIDs) which have the same structure as those used in the SNOMED CT International Release. However, these identifiers include a partition-identifier indicating that the component is part of an extension and a namespace identifier specific to the responsible organisation.

Partition-identifiers and namespace identifiers serve two roles:

- Prevention of identifier collision or reuse:
  - Organisations responsible for an extension must only issue components within their allocated namespace and must not reuse any identifier within that namespace once it has been issued.

- Indicating the origin of an identified component:
  - If an application receives instance data containing an identifier that it does recognise, the application can use the namespace identifier to determine the responsible issuing organisation.
  - The responsibility for an allocated namespace remains with the organisation to which it was issued unless responsibility is transferred by merger or mutual agreement. Any namespace transfer must be notified to and authorised by the IHTSDO.
10.3 Moving components between namespaces

The namespace-identifier identifies the Extension in which the component originated. However, within specified limits and with agreement between the responsible organisations, the maintenance responsibility may be reassigned without issuing a new Identifier. Therefore, the namespace-identifier may not identify the Extension in which a component is now maintained.

The permitted reassignments of responsibility are limited to ensure that the organisation responsible for maintaining a component can be determined. Thus the end result of any transfer of responsibility must result in the component being maintained by the organisation responsible for one of the following:

- the Extension namespace specified by the namespace-identifier of its Identifier;
- an Extension with a namespace-identifier that is a hierarchical ancestor of the namespace-identifier of the originating Extension;
- the International Release.

The values of the of the partition-identifier which previously indicated that a component was part of an Extension, continue to indicate that the SCTID contains a namespace-identifier. However, some components with a namespace-identifier may now be maintained as part of the International Edition. Therefore, for clarity, the definition of partition-identifier indicates whether the SCTID conforms to the long format (with a namespace-identifier) or the short format (without a namespace-identifier). Only the IHTSDO can issue short format SCTIDs (without a namespace), whereas an Extension owner must issue a long format SCTIDs (including a namespace-identifier that is registered as belonging to them).

The moduleId field, introduced in Release Format 2 and held against each component, records the organisation currently responsible for maintaining the component. The moduleId must refer to a module delivered by the organisation maintaining the component and the namespace-identifier of this moduleId must belong to the maintaining organisation.

Following the change, migration of components between Extensions would be possible without a change to their SCTIDs, according to the following rules:

- A component can be moved from any Extension to the International Release without a change to its SCTID.
- A component can be moved from an Extension to a parent or ancestor Extension without a change to its SCTID.
- A component can be moved from the International Release back to its originating Extension without a change to its SCTID.

In all other cases, the existing rules for moving components between Extensions should be used. These require a change of SCTID to occur with tracking of inactivation in the appropriate Component Inactivation Reference Set and cross-references created in the appropriate Historical Association Reference Set (or as historical relationships in Release Format 1).

⚠️ Caution: Components that originated in the International Release must not be moved to any Extension without a change to the SCTID.

In order to make explicit which Extensions are parents of which other Extensions, concepts under the Namespace Concept may now be rearranged as a nested hierarchy of namespaces. All namespaces at the top level of this hierarchy are considered to have as their parent the International release. The Namespace Concept for an Extension that is dependent on another Extension may be nested as a child (sub-type) of the Namespace Concept for the Extension on which it depends.

⚠️ Caution: Components that originated in an Extension must not be moved to any other Extension unless the Namespace Concept associated with the target Extension is an ancestor of Namespace Concept associated with source Extension. The ancestry of Namespace Concepts is determined by the subtype hierarchy distributed as part of the International Release. Other moves between Extensions require a change of SCTID.
Guidance has been developed for producers and consumers of SCTIDs, to help avoid conflicts of ownership and to facilitate identification of owning organisations (see Guidance for Producers of SNOMED CT Identifiers and Guidance for Consumers of SNOMED CT Identifiers).

10.3.1 Guidance where RF1 format is used for an Extension

Where a namespace owner is still releasing an Extension using Release Format 1 (RF1), then content should continue to be moved from and to that Extension by creating new SNOMED CT identifiers and using the old “move to / move from” mechanism.

Consumers of RF1 releases or conversions of Extensions should be aware that content may have been moved to the International Release, or to a parent Extension, without a change of SCTID. Therefore, these Extensions and so may contain components from with different.

10.4 Guidance for Consumers of SNOMED CT Extensions

10.4.1 Guidance on validating SCTIDs within an Extension

The following checks may be performed to validate the consistency of SCTIDs in one or more Extensions:

- An Extension should only contain components that have a namespace owned by the releasing organisation, or a child of a namespace owned by the releasing organisation. Note however, that a releasing organisation may merge content from its Extension(s) with one or more parent Extensions and the International release into a single release file.
- The primary key for component versions held as rows in release files is the composite of the SCTID and the effectiveTime. No two component versions should have the same primary key, either within or across all Extensions. Once loaded, the state valid history of a component across all loaded Extensions should be taken in the normal effectiveTime order.
- If a child Extension releases a new version of a component that has not been inactivated within the parent Extension, then there is an error. The version of the component in the parent Extension should be taken as the correct version of the component (as they have not formally released control of it), and the error should be reported to the owner of the child Extension.
- The check digit of each SCTID may be validated using the check-digit algorithm.

The following provides examples of possible errors that can be picked up as part of a validation process:

Here, the release file contains a concept that has a namespace that is not a child or parent namespace of namespace 0009999.

**Extension for namespace 0009999:**

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleId</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20071031</td>
<td>1</td>
<td>[Module 1]</td>
<td>[Primitive]</td>
</tr>
</tbody>
</table>

Here, the concept has been incorrectly inactivated in an Extension at the same effectiveTime as the new concept version has been included in the International release. A clash in primary keys of the two concept versions has resulted.

**Extension for namespace 0989121:**

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleId</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20071031</td>
<td>1</td>
<td>[Module 1]</td>
<td>[Primitive]</td>
</tr>
<tr>
<td>1290989121103</td>
<td>20080131</td>
<td>0</td>
<td>[Module 1]</td>
<td>[Primitive]</td>
</tr>
</tbody>
</table>
Here, the concept has not been deactivated in the International release before it was reinstated in an Extension. This is an error that would result in consumers of the International release receiving the 31st January version of the concept, with consumers of Extension 0989121 (and the International release) receiving 31st October version of the concept, resulting in risks to semantic interoperability. In this case, the 31st January version included in the International release should be taken as the correct version and the error should be reported to the owner of Extension 0989121.

Extension for namespace 0989121:

10.4.2 Guidance on identifying the maintaining authority for a component

Where information about a component is available (either from release files or from a terminology server), then the moduleId of the component can be used to identify its maintaining authority. As an example, take the following case, where a concept was created by the owner of namespace 0989121, but then subsequently transferred to IHTSDO:

Extension for namespace 0989121:
10.4.3 Guidance on parsing and identifying SCTIDs

The constraints on the value range for SCTIDs allow a consistent string and integer representation of these values. The upper limit of 18 digits ensures that any valid SCTID can be stored in either a signed or unsigned 64-bit integer. The lower limit of six digits ensures that a SCTID can be distinguished from:

- A Read Code, which is 5 characters in length, padded out with dots if necessary.
- A SNOMED ID, which always starts with a letter.

10.4.4 Guidance on using state valid data

When receiving data from an Extension owner, care should be taken when reviewing historical data only to use snapshots of data relating to one of the release points for that Extension. It is only at these release points that the content in the Extension is consistent with the content in the International release and/or any parent Extensions.

For example, take the case where the International edition is released in January and an Extension is released in April. Generally, the Extension will be dependent on the International release, and may, for example, hold a concept that is a child of a parent concept in the International release. Now, if the parent concept is amended or even retired in January, the child concept will need to be reviewed, modified and perhaps moved to another part of the hierarchy to take account of the changes in the International release. Generally, the reason that the Extension is released a few months after the International release and not earlier is that the Extension owner needs to review the changes in the International release, modifying the content in the Extension to keep it consistent. Once the April release is made, the Extension and the International release will be consistent, and before the April release, consumers of the Extension should use the previous (July) version of the International release supplied by the Extension owner. So once the April release is made, the Extension and the International release are consistent, but any historic state between January and April will be inconsistent. In practise, this is not a big issue, as no changes will have been made between January and April.

10.5 Guidance for Producers of SNOMED CT Extensions

Prerequisites

Before generating SCTIDs, an organisation must own a namespace. A namespace can be requested from IHTSDO by emailing a request to info@ihtsdo.org.

Guidance on Generating SCTIDs

The following guidance is provided for owners of namespaces that generate new content:

- An organisation should only generate new SCTIDs for components within a namespace that they own.
- An organisation should have a mechanism in place to ensure that SCTIDs are not assigned multiple times. Generally, a single authority that generates item-identifiers in a sequential fashion for each type of component will achieve this goal.
- Generally, SCTIDs should be generated for new components as part of the release process for an Extension, rather than during the edit process. This is to avoid unnecessary usage of Identifiers for Concepts that are created during editing but found not to be required prior to release.
- item-identifiers should not be generated so as to have meaning. They should be regarded as meaningless numbers.

Guidance on Packaging Content

Organisations may package content into release files in a number of ways:
• All content for a particular type of component (e.g.: of type Concept) that is owned by the organisation can be released in a single file. Components in this file may have different moduleIds, where the content has been authored by more than one group in the organisation and each group has its own moduleId. Content that is owned by parent organisations may be held in separate files that are also included in the release. Content owned by other organisations should not be included in the release.

• As above, but components with different moduleIds can be released in separate files.

• As the first bullet above, but content from parent organisations may be included in the same release files as content owned by the releasing organisation. In this case, the ownership of each component can be identified by reference to its moduleId. Care should be taken not to modify, add to or remove content that is owned by a parent organisation, as this would be considered as editing content that the organisation did not own.

Guidance on Promoting Components

Components (whether Concepts, Descriptions or Relationships) may be promoted to a parent Extension or to the International release. In order to achieve this, the donating organisation should contact IHTSDO or the owner of the receiving Extension with details of the components that are to be promoted.

The definition of the component in the source Extension should not change (for example, a new record should not be added to the source Extension to inactivate the component). Once the component has been promoted to a parent Extension, care should be taken not to amend or inactivate it within its original Extension.

A Component should only be promoted to the International release or to an Extension that is associated with a namespace that is a parent of the namespace of the component.

Guidance on Receiving Promoted Components

Before receiving content into a parent Extension or the International release, details of the components that are to be transferred should be received in writing from an authority within the source organisation.

The component should then be included in the next release of the parent Extension or of the International release, with the following fields amended:

• effectiveTime – to be set to the Extension's release date, as normal.
• moduleId – set to the moduleId of the new maintaining organisation.

The SCTID of the component should not change when it is included in the new Extension or the International release.

Guidance on Defaulting Components to their Original Extension

Where a component has been promoted to a parent Extension or to the International release (perhaps incorrectly), and it is required to default that component back to its original Extension, then the parent organisation should contact the owner of the components' original Extension with details of the components that are to be moved.

The component should then be included in the next release of the parent Extension or of the International release, with the following fields amended:

• effectiveTime – to be set to the Extension's release date, as normal.
• active – set to false.

At this point, the component will be retired for all consumers of the parent Extension or the International release.

The component should then be included in the next release of the original Extension to which the component is to be moved, with the following fields amended:

• effectiveTime – to be set to the Extension's release date, as normal.
• moduleId – set to the moduleId of the new maintaining organisation.

The SCTID of the component should not change when it is included in the receiving Extension. Care should be taken to ensure that the effectiveTime of the inactivation record in the donating Extension is
prior to the effectiveTime of the record in the receiving Extension. The donating Extension should always inactivate the component before it is included in the receiving Extension. In particular, the effectiveTimes should not be set to the same date in order to avoid a primary key conflict for the component across the Extensions.

The following example shows how a Concept can be created in an Extension, promoted to the International release and then be defaulted to its original Extension without changing its SCTID. In this example, |Module 1| is owned by namespace 0989121 and |Module 2| is owned by IHTSDO.

A concept is first created in Extension 0989121:

**Extension for namespace 0989121**:

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleld</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20071031</td>
<td>1</td>
<td></td>
<td>Module 1</td>
</tr>
</tbody>
</table>

It is then included in the International release. At this stage, IHTSDO owns the concept. Note that there is no need to deactivate the concept in the Extension as the Extension is dependent on the International release, and therefore can only be used in conjunction with the International release. Because of the state valid representation of RF2, the new concept version added to the International release automatically supersedes the previous concept version in the Extension. Also, |Module 2| supersedes |Module 1| as the new module in which this concept is now authored:

**Extension for namespace 0989121**:

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleld</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20071031</td>
<td>1</td>
<td></td>
<td>Module 1</td>
</tr>
</tbody>
</table>

**International release**:

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleld</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20080131</td>
<td>1</td>
<td></td>
<td>Module 2</td>
</tr>
</tbody>
</table>

Then, IHTSDO inactivates the concept within the International release:

**Extension for namespace 0989121**:

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleld</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20071031</td>
<td>1</td>
<td></td>
<td>Module 1</td>
</tr>
</tbody>
</table>

**International release**:

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleld</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20080131</td>
<td>1</td>
<td></td>
<td>Module 2</td>
</tr>
<tr>
<td>1290989121103</td>
<td>20080731</td>
<td>0</td>
<td></td>
<td>Module 2</td>
</tr>
</tbody>
</table>

Finally, the original Extension owner can include the concept within their own Extension again. At this stage, the concept will be inactive to all consumers of the International release that do not also consume Extension 0989121:

**Extension for namespace 0989121**:

<table>
<thead>
<tr>
<th>SCTID</th>
<th>effectiveTime</th>
<th>Active</th>
<th>moduleld</th>
<th>definitionStatusId</th>
</tr>
</thead>
<tbody>
<tr>
<td>1290989121103</td>
<td>20071031</td>
<td>1</td>
<td></td>
<td>Module 1</td>
</tr>
</tbody>
</table>
Guidance on other Movement of Components between Extensions

All other movement of components between Extensions, including moving content that was created in the International release to an Extension, or from one Extension to another unrelated Extension should be performed by inactivating the component from the source Extension and creating a new component in the receiving Extension, as is described in the SNOMED CT Technical Reference Guide.

The reasons for constraining movement of components between Extensions in this way are:

a) To ensure that two components with the same SNOMED CT identifier are not released independently (and perhaps inconsistently) in two separate Extensions.

b) To allow a consumer to validate that the owner of an Extension has the authority to release all the components included in their release.

If it were allowed for a component to be retired from the International release and moved to an Extension while keeping the same SNOMED CT identifier, then it would be possible for more than one Extension owner to include the component in their Extension (perhaps over a period of time). This would result in issue (a) above. IHTSDO would have no way of monitoring this, or providing guidance to consumers of Extensions, to allow them to validate ownership of components within an Extension (issue b above). More seriously, once a component is in two separate Extensions with the same SNOMED CT identifier, then it may get modified in different ways in each Extension over time, causing interoperability issues.
# Chapter 11

## 11 SNOMED CT file and field names

This section lists the file and field names used in technical specifications within this guide. The scope of use of these names is limited to the tables in which they are used and the given definitions are not intended for use in any other context.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>acceptabilityId (field)</td>
<td>A field in a 900000000000506000</td>
</tr>
<tr>
<td>active (field)</td>
<td>A Boolean field that specifies whether an identified component or is an active from the point in time specified by the effectiveTime.</td>
</tr>
<tr>
<td>alternateIdentifier (field)</td>
<td>A field in the Identifier file containing the representation of an Identifier in another code system that is irrevocably linked to a SNOMED CT identifier.</td>
</tr>
<tr>
<td>annotation (field)</td>
<td>An Annotation Reference Set field containing additional information linked to a SNOMED CT component.</td>
</tr>
<tr>
<td>attributeDescription (field)</td>
<td>A reference to a concept that specifies the name and/or usage of an additional attribute in a Refset. If the attributeType is component reference, the values applied to this additional attribute are restricted to subtypes of this concept.</td>
</tr>
<tr>
<td>attributeOrder (field)</td>
<td>An integer representing the position of an additional attribute in a Refset. The value 0 (zero) refers to the referencedComponentId. All other values refer to the position of an additional attribute relative to the referencedComponentId.</td>
</tr>
</tbody>
</table>
attributeType (field)
A reference to a concept that specifies the data type of an additional attribute in a Refset.

Note: Field name in a SNOMED CT Release Format 2 Reference Set Descriptor.

B

Boolean (data type)
A datatype that represents either true or false.

Note: In SNOMED CT release files the value 0 (zero) represents "false" and the value 1 (one) represents true.

C

caseSignificanceId (field)
A field in the Description Release File containing a SNOMED CT identifier that indicates whether the text of the term can be modified by switching characters from upper to lower case (or vice-versa).

Note: Field name in SNOMED CT Release Format 2

characteristicTypeId (field)
A reference to a concept that specifies the nature of a Relationship. Values include "defining", "qualifying" etc.

Note: Field name in the SNOMED CT Release Format 2 relationships table.

Concept file
The file structure used to distribute SNOMED CT concepts.

Note: Component File name in SNOMED CT Release Format 2

conceptId (field)
A field in the Description file that associates a term with the concept to which it applies.

Note: Field name in the Description file.

correlationId (field)
A field in the Complex Map Reference Set containing a SNOMED CT identifier which represents the correlation between the SNOMED CT concept and the target code.

Note: Field name in SNOMED CT Release Format 2
**definitionStatusId (field)**
A field in the Concept Release File containing a SNOMED CT identifier which specifies whether the concept is fully defined or primitive.

**Note:** Field name in the SNOMED CT Release Format 2 concepts table.

**Description file**
The file structure used to distribute SNOMED CT descriptions.

**Note:** Component File name in SNOMED CT Release Format 2

**descriptionFormat (field)**
A Description Format Reference Set field reference to a concept that specifies the maximum length and format of the term fields for a particular type of Description.

**Note:** By default the term is a UTF-8 string of up to 255 characters without markup. However, description types can be specified which are longer in length and/or contain format markup (e.g. HTML). For more details of how this is specified see the file structure specification.

**descriptionLength (field)**
A Description Format Reference Set field containing an integer which indicates the maximum length of the term string for a specified type of Description.

**Note:** By default the term is a UTF-8 string of up to 255 characters without markup. However, description types can be specified which are longer in length and/or contain format markup (e.g. HTML). For more details of how this is specified see the file structure specification.

**destinationId (field)**
A field in the Relationship Release File containing a SNOMED CT identifier that refers to the concept that represents the destination (or attribute-value) of the associated Relationship.

**Note:** Field name in SNOMED CT Release Format 2. In RF1 this field was called ConceptId2

**Dualkey (field)**
A key used to facilitate textual searches of SNOMED CT that consists of the first three letters of a pair of words in a Description. All possible pairs of words in each Description may be paired irrespective of their relative position in the Description. Dualkeys are represented as a row in the Dualkeys Table.

**Note:** Field name in SNOMED CT toolkit

**Dualkey table**
A table in which each row represents a Dualkey. See [see Word Search Tables - Summary on page 116].

**Note:** File or Table name in SNOMED CT toolkit
**effectiveTime** (field)

Specifies the inclusive date at which the component version's state became the then current valid state of the component.

*Note:* Field name in SNOMED CT Release Format 2

**Excluded word** (field)

A word that in a given language is so frequently used, or has so poor a discriminating power, that it is suggested for exclusion from the indices used to support textual searches of SNOMED CT. Excluded Words are represented as a row in the Excluded Words Table.

*Note:* Field name in SNOMED CT toolkit

**Excluded words table**

A data table in which each row represents an Excluded Word. See [see Word Search Tables - Summary](#) on page 116.

*Note:* File or Table name in SNOMED CT toolkit

**Identifier file**

The file structure used to distribute alternative Identifiers for SNOMED CT components.

*Note:* The Identifier file is not currently used in the SNOMED CT International Release as use of the more flexible Simple map type references set structure is preferred for links to alternative codes. The only known current use of this file is for internal identification of components during the content development process.

**id** (field)

A field that provides the unique identifier of a component (concept, description or relationship) or reference set member.

*Note:*

- The data type of the id for a component is SCTID and this identifier is used to refer to the component.
- The data type of the id for a reference set member is UUID. This identifier is only used to support versioning of a rows (member) in a Reference set it does not identify the Reference set itself (see refsetId) nor does it identify to a component refered to by the Reference set (see referencedComponentId).

**identifierSchemeld** (field)

A field in the RF2 Identifier file containing a SNOMED CT identifier which identifies the alternate code system.

*Note:* In practice, the identifier file is not used in the SNOMED CT International Release as the use of Simple map type references sets is preferred. The only current use of this file is for internal identification during the development process.
Integer (data type)
A datatype that represents a whole number.

Note: In SNOMED CT release file specifications integers are represented as a string of decimal digits. The range of values and support for negative values may be constrained for the specification are specified for each usage of this datatype. However, unless otherwise specified, all release file fields of data type integer are assumed to be 32-bit signed integers.

Keyword (field)
A field containing a potential search text in one of the WordKey Tables or a word excluded for key generation in the Excluded Words Table.

Note: Field name in SNOMED CT toolkit

linkedToId (field)
An Ordered Reference Set field containing a SNOMED CT identifier which refers to either a sub-group of components or a child concept in the alternative hierarchy represented by the Reference set. The parent of grouping component is represented by the referencedComponentId.

Note: Field name in SNOMED CT Release Format 2.

mapAdvice (field)
Field in a Complex or Extended Map Reference Set containing human-readable advice, that may be employed by the software vendor to give an end-user advice on selection of the appropriate target code from the alternatives presented to him within the group.

mapGroup (field)
Field in a Complex or Extended Map Reference Set containing an integer that groups a set of complex map records from which one may be selected as a target code. Where a SNOMED CT concept maps onto ‘n’ target codes, there will be ‘n’ groups, each containing one or more complex map records.

mapCategoryId (field)
Field in a Complex or Extended Map Reference Set that identifies the SNOMED CT concept in the metadata hierarchy which represents the MapCategory for the associated map member.

Note: The categories vary for different target code systems, each set of categories is represented by a subtype of 609331003|Map category value|. For example in the case of ICD-10 the individual category values are subtypes of:
447634004|ICD-10 Map category value|
mapPriority (field)
Field in a Complex or Extended Map Reference Set that specifies the order in which complex map records should be checked. Only the first map record meeting the run-time selection criteria will be taken as the target code within each mapGroup.

mapRule (field)
Field in a Complex or Extended Map Reference Set containing a machine-readable rule, (evaluating to either 'true' or 'false' at run-time) that indicates whether this map record should be selected within its mapGroup.

mapTarget (field)
Field in a Simple Map Reference Set or a Complex or Extended Map Reference Set that contains the target code(s) to which the SNOMED CT concept represented the referencedComponentId is mapped in the target scheme.

modifierId (field)
A field in the relationship file that indicates the description logic modifier that applies to that defining Relationship (e.g. "some" or "all").

Usage: Field name in SNOMED CT Release Format 2.

moduleId (field)
A field in each component release file which represents the development module within which it was created and is maintained.

Note: Field name in SNOMED CT Release Format 2, which is specified in [see Identification of Source Module].

O

order (field)
Order... to be defined.

Note: Field name in SNOMED CT Release Format 2

Q

query (field)
A field in a Query specification reference set that contains a text string representing criteria for selection of SNOMED CT components to be included in Simple reference set

Note: A standard syntax for use in these queries is currently under development and is due for publication in late 2014.
**referredComponentId (field)**
A field in a Reference Set containing an Identifier which refers to the component to which a row in the Reference Set applies.

*Note:* This field is present in all types of Reference Set and, unless otherwise specified, the field data type is SCTID.

**Reference Set file**
The file structure used to distribute SNOMED CT Reference sets. **Alternatives**
- Refset file

**refsetId (field)**
A field in a Reference Set which uniquely Identifier which refers to the component to which a row in the Reference Set applies.

*Note:* This field is present in all types of Reference Sets and its data type is SCTID. It links together all the members of a Reference Set and refers to a concept that names the Reference Set.

**Relationship file**
The file structure used to distribute SNOMED CT relationships. **relationshipGroup (field)**
Field in the Relationship File is used to group Relationships together for a concept. For example, where a particular type of prosthesis is inserted a joint, the Defining characteristics describing the prosthesis type would be in one group whereas those describing the location or laterality of the joint would be in another group.

**S**

**SCTID (data type)**
A unique integer identifier applied to each SNOMED CT component (Concept, Description, Relationship).

*Note:* The value of an SCTID is structured to include an item identifier, a check-digit and a partition identifier. Depending in the value of the partition identifier it may also include a namespace identifier.

**sourceEffectiveTime (field)**
A field in the Module Dependency Reference Set which specifies the effectiveTime of the version of the source module with depends on the specified version of the target module. The effectiveTime must match exactly.

*Note:* Field name in SNOMED CT Release Format 2

**sourceId (field)**
A field in the Relationship Release File containing a SNOMED CT identifier that refers to the concept that represents the source of the associated Relationship. The sourceId refers to the concept that is defined by the Relationship.
Note: Field name in SNOMED CT Release Format 2. In RF1 this field was called ConceptId1

Stated Relationship File

A distribution file containing the stated form of SNOMED CT relationships.

Notes:

1. The stated form of a Concept is the Description Logic definition that is directly edited by authors or editors. It consists of the stated | is a | relationships plus the defining relationships that exist prior to running a classifier on the logic definitions. Therefore, the stated form of a Concept is represented by a collection of relationships: one or more | is a | relationships and zero or more defining relationships.
2. The Stated Relationships File is in the same table format as the Relationships File, but the value of the characteristicTypeId field is | Stated relationship (core metadata concept) |.

Related Links

Stated Relationships File on page 100
Stated definition view on page 51
Inferred definition views on page 52

String (data type)

A datatype representing a sequence of characters.

Note: In SNOMED CT release file specifications strings are represented using Unicode UTF-8 encoding.

T

targetComponentId (field)

An Association Reference Set field containing a SNOMED CT identifier which specifies the target of the association from the source component (e.g. a concept or Description) referred to by the referencedComponentId.

Note: Field name in SNOMED CT Release Format 2.

targetEffectiveTime (field)

A field in the Module Dependency Reference Set which specifies the effectiveTime of the version of the target module on which the specified version of the source module depends. The effectiveTime must match exactly.

Note: Field name in SNOMED CT Release Format 2

term (field)

A text string that represents the concept referenced by the conceptId field in the Description file.

Note:

By default the term is a UTF-8 string of up to 255 characters. However, description types can be specified which are longer in length and/or contain format markup (e.g. HTML).

Field name in the Description file.

Time (data type)
A datatype representing a date or time.

**Note:** In SNOMED CT release file specifications date and times are represented as strings using the ISO 8601 basic format.

- The date format used is YYYYMMDD.
- Where time is included the format is YYYYMMDDThhmmssZ. The time is separated from the date by the letter "T" and followed by the letter "Z" indicating that the timezone is UTC.

**Examples:**
- July 31st 2012: **20120731**.
- 13:15 UTC on August 2nd 2012: **20120802T131500Z**.

**Transitive closure file**
The file used to distribute the transitive closure of the SNOMED CT subtype hierarchy.

**Note:** This file is not currently distributed but can be generated from the Relationships file using a script.

**typeld (field)**
A field in the Description and Relationship Release Files which contains a SNOMED CT identifier that represents the type of Description or Relationship represented.

- **Description. typeld** represents the type of Description. Description types include subtypes of 900000000000446008 | Description type (core metadata concept) |. These include 90000000000013009 | Synonym (core metadata concept) | and 900000000000003001 | Fully specified name (core metadata concept) |. There is no typeld value for "Preferred term" as the preferred term is the synonym marked as "Preferred" in the appropriate [see Language Reference Set].
- **Relationship. typeld** represents the type of Relationship between the concept identified by sourceld and the concept identified by destinatonld. Relationship types are 116680003 | Is a (attribute) | and subtypes of 410662002 | Concept model attribute (attribute) |.

**Note:** Field name in the Description file and in the Relationship file.

**Unicode**
A standard character set, which represents most of the characters used in the world using a 16-bit encoding.

**Note:** The Unicode character set can be encoded using either UTF-16 or UTF-8. UTF-16 uses two bytes for every character. UTF-8 is able to store the most commonly used characters in western alphabets using a single byte, but it requires two bytes to encode accented characters and three bytes to encode symbols used in many non-European scripts.

**UTF 16**
A standard method of directly encoding Unicode using two bytes for every character.

**Note:** SNOMED CT release files do not use UTF-16. However, the UTF-8 representation used in release files can be converted to UTF-16.

**UTF-8**
A standard method of encoding Unicode characters in a way optimised for the ASCII character set. UTF-8 is described in [see Unicode UTF-8 encoding on page 107].
UUID (data type)
A datatype representing a sequence of unique Identifier encoded as a 128-bit integer.

Note: In SNOMED CT release files UUIDs are represented using as a string following the standard canonical form. In this string form a UUID is represented by 32 hexadecimal digits, displayed in five groups separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 digits and four hyphens).

Example: ac527bed-9c70-4aad-8fc9-015828b148d9

Alternatives
Universally Unique Identifier
GUID
Globally Unique Identifier

V

valueld (field)

Note: Field name in SNOMED CT Release Format 2

W

Word equivalents table
A data table in which each row represents a Word Equivalent. See [see Word Equivalents on page 117].

Note: File or Table name in SNOMED CT toolkit

WordBlockNumber (field)
A field in the Word Equivalents Table, which links together several rows which have an identical or similar meaning.

Note: Field name in SNOMED CT toolkit

WordKey table
A data table relating each word used in SNOMED CT (other than Excluded Words) to the Descriptions. See [see Word Search Tables - Summary on page 116].

Note: File or Table name in SNOMED CT toolkit

WordRole (field)
A field in the Word Equivalents Table, which specifies the usual usage of this word, abbreviation or phrase, or the usage in which it has a similar meaning to the text in one or more other rows of the table that share a common WordBlockNumber.

Note: Field name in SNOMED CT toolkit
**WordText (field)**
A field in the *Word Equivalents Table*, which contains a word, phrase, acronym or abbreviation that is considered to be similar in meaning to the text in one or more other rows of the table that share a common *WordBlockNumber*.

**Note:** Field name in SNOMED CT toolkit

**WordType (field)**
A field in the *Word Equivalents Table*, which specifies whether this row contains a word, phrase, acronym or abbreviation.

**Note:** Field name in SNOMED CT toolkit
Chapter 12

References

12.1 SNOMED CT Background

12.1.1 SNOMED CT: A Comprehensive terminology for Health Care

SNOMED Clinical Terms (SNOMED CT) was developed between 1999 and 2002 from a convergence of the content of SNOMED Reference Terminology® (SNOMED RT) and NHS Clinical Terms Version 3 (CTV3). This convergence was a result of a strategic alliance to between the College of American Pathologists (CAP) and the UK National Health Service. In 2007, the International Health Terminology Standards Development Organisation acquired SNOMED CT and now develops and maintains it on behalf of its Members and Affiliates.

SNOMED CT combines the robust strength of SNOMED RT in the basic sciences, laboratory and specialty medicine with the highly granular clinician focused content of CTV3 (formerly known as the Read Codes). The result is a comprehensive and precise clinical reference terminology that provides unsurpassed clinical content and expressivity for clinical documentation and reporting. SNOMED CT enables clinicians, researchers and patients to share comparable data worldwide, across medical specialties and sites of care.

SNOMED CT is founded on four basic principles that have guided development of its clinical content and technical design. These principles will continue to guide the evolution of SNOMED CT as it adapts and grows in the ever changing global health care environment.

These guiding principles are:

1. Development efforts must encompass broad, inclusive involvement of diverse clinical groups and medical informatics experts;
2. The clinical content must be quality focused and adhere to strict editorial policies;
3. The quality improvement process must be open to public scrutiny and vendor input, to ensure that the terminology is truly useful within healthcare applications;
4. There must be minimal barriers to adoption and use.

The design of SNOMED CT has been driven by the expressed needs of software developers for features that improve their ability to develop useful applications. In response to these needs, the design adds unique numeric Identifiers; includes links to legacy codes; supports a sustainable migration and maintenance strategy; permits adaptability for national purposes; and fosters alignment with other terminologies and standards such as HL7, LOINC, and DICOM.

The IHTSDO believes that SNOMED CT delivers a standardised quality clinical terminology that is required for effective collection of clinical data, its retrieval, aggregation and re-use as well as the sharing, linking and exchanging of medical information.

The file format used for distributing SNOMED CT content between 2002 and 2011, which is now known as Release Format 1 (RF1), was balloted and approved as an ANSI standard. An enhanced file format, Release Format 2 (RF2), has been approved and adopted by the IHTSDO. As RF2 is phased in during 2011, it will simplify change management and add robust facilities for future extensibility.
12.1.1.1 SNOMED CT Quality Development Process

The SNOMED Clinical Terms development process incorporates the efforts of a team of internal and external modelers. A documented scientific process is followed which focuses on Understandability, Reproducibility and Usefulness. Content is defined and reviewed by multiple clinician editors. Conflicts between editors are resolved through an iterative process, based on achieving agreement and consensus, before being entered into the terminology. As necessary, additional experts are consulted to review the scientific integrity of the content.

The integration of SNOMED RT and Clinical Terms Version 3 to create the first release, was a three year process that involved several stages of review and quality assurance:

- **Description mapping**: NHS editors evaluated each SNOMED CT concept and term and mapped it to the Clinical Terms Version 3 terminology; SNOMED CT editors performed the same task mapping primarily disorders and procedures from Clinical Terms Version 3 to SNOMED RT.
- **Description mapping conflict resolution**: Mapping discrepancies that occurred between NHS and SNOMED CT editors underwent a conflict resolution process to definitively place each concept within the merged hierarchy.
- **Auto-classification**: The merged database following description mapping conflict resolution underwent a series of quality control checks including auto-classification to identify and eliminate cycle errors (e.g. concept A is a | B and concept B is a | A) and equivalency errors (e.g. where two defined concepts have the exact same definition).
- **Hierarchy review**: The reviewed database has undergone auto-classification and further review of inferred hierarchies.
- **Ongoing refinement**: The quality control process is continuously supplemented by feedback from users involved in adoption of SNOMED Clinical Terms.

12.1.1.1.1 Extent of Review

The quality processes used in the development of SNOMED CT were complemented with external review.

- **Technical review**: The technical specifications for SNOMED CT were published for comment on both the SNOMED CT and NHS websites.
- **Alpha test review**: Forty-two organisations in six countries tested the SNOMED CT alpha test file and completed a structured assessment instrument.
- **Alpha test feedback**: Debriefing sessions were conducted in the US, in the UK and in Australia, at which time test sites shared their positive experiences and recommendations for improvement.
- **Peer review**: The methods used in developing SNOMED CT were presented in 6 scientific papers at the 2001 American Medical Informatics Association (AMIA) meeting, the largest association of leaders in medical informatics in the world. SNOMED CT was also part of an additional three papers and six posters at the 2002 AMIA meeting and additional posters for AMIA 2003 and 2004.

SNOMED CT was also the subject of papers in the American Health Information Management Association (AHIMA) Journal in 2001-2003, posters at 2001 and 2002 annual meetings and presentations at the 2003 and 2004 annual meetings. In addition, AHIMA introduced an education programme "Introduction to Clinical terminology" in 2004 which included a SNOMED CT.

Early adopters of SNOMED RT (a structure that mirrored SNOMED CT core tables) were debriefed on their implementation experience in order to identify the key issues to be addressed in the original version of the SNOMED CT Technical Implementation Guide.

12.1.1.2 Continuous Quality Improvement

Continuous improvement is an aim of the IHTSDO: Updating the breadth and scope of the content to reflect changes in clinical care and advances in medical science; refining the content to deliver greater precision for data collection, retrieval and aggregation; and enhancing the functionality to serve our users better.

12.1.2 Acknowledgments of Contributors to SNOMED CT®

SNOMED CT was originally created by the College of American Pathologists.
SNOMED CT has been created by combining SNOMED RT and a computer based nomenclature and classification known as Clinical Terms Version 3, formerly known as the Read Codes Version 3, which was created on behalf of the U.K. Department of Health and is Crown copyright.

The IHTSDO also acknowledges the contributions of:

- The American Academy of Ophthalmology, for the ophthalmology-related portions of this work.
- LOINC®, the Logical Observation Identifier Names and Codes, copyright 1995-2008, Regenstrief Institute LOINC Committee. All rights reserved.
- NANDA®, North American Nursing Diagnosis Association Taxonomy II, copyright 2005-2008, NANDA International. All rights reserved.
- The Perioperative Nursing Data Set® (PNDS), copyright 2002, AORN, Inc. All rights reserved.
- The Omaha System, copyright 1992, Martin and Associates. Used with permission.
- The Clinical Care Classification, copyright 2004, V.K. Saba. Used with permission.
- The Nursing Interventions Classification (NIC), copyright 2004, Mosby, Inc., and the Centre for Nursing Classification and Clinical Effectiveness at the University of Iowa College of Nursing. Used with permission.
- The Nursing Outcomes Classification (NOC), copyright 2004, Mosby, Inc., and the Centre for Nursing Classification and Clinical Effectiveness at the University of Iowa College of Nursing. Used with permission.
- This work contains terms from the British Association of Dermatology (BAD), and is used by permission of BAD. Crown Copyright 2003 The Royal College of Anaesthetists.
- This work contains terms from The Royal College of Anaesthetists (RCoA), and is used by permission of RCoA. Crown Copyright 2003 The Royal College of Anaesthetists.
- This work contains terms from the Authorised Osteopathic Thesaurus, and is used by permission of the American Association of Colleges of Osteopathic Medicine and the American Osteopathic Association.

HL7 version 3 - An object-oriented methodology for collaborative standards development


Desiderata for controlled medical vocabularies in the twenty-first century


This paper identifies some of the key requirements for a clinical terminology. The topics covered include:

- Vocabulary content;
- Concept orientation;
- Concept permanence;
- Non-semantic concept identifiers;
• Polyhierarchy;
• Formal definitions;
• Rejection of "not elsewhere classified" terms;
• Multiple granularities;
• Multiple consistent views;
• Context representation;
• Graceful evolution;
• Recognised redundancy.

HL7 Reference Information Model


Quality of clinical information retrieval using a semantic terminological model


Lexically Assign, Logically Refine strategy for integrating overlapping terminologies


Integration of tools for binding archetypes to SNOMED CT

Integration of tools for binding archetypes to SNOMED CT, Erik Sundvall, Rahil Qamar, Mikael Nyström, Mattias Forss, Håkan Petersson, Daniel Karlsson, Hans Åhfeldt and Alan Rector; BMC Medical Informatics and Decision Making 2008, 8(Suppl 1):S7

Normal forms for description logic expressions of clinical concepts in SNOMED RT

Representing clinical information using SNOMED CT with different information models


Toward vocabulary domain specifications for health level 7-coded data elements

Chapter 13

13 Glossary

This section contains selected terms from the IHTSDO Glossary. The full IHTSDO Glossary is available as follows:

- Online access: www.ihtsdo.org/gl;
- PDF file (US English): www.ihtsdo.org/gl.pdf;

Active component

A SNOMED CT component that is intended for use. Release files contain Active and Inactive components to provide a historical record of the content of the terminology at different points in time.

Note: A component is active when the most recent row with the relevant Component.id in the Full Release of the relevant Release File has the value Component.active=1 (one). The most recent row for a component is determined based on the Component.effectiveTime value.

Active concept

A Concept that is intended for use. Release files contain Active and Inactive components to provide a historical record of the content of the terminology at different points in time.

Note: A component is active when the most recent row with the relevant Component.id in the Full Release of the relevant Release File has the value Component.active=1 (one). The most recent row for a component is determined based on the Component.effectiveTime value.

Active description

A Description that is intended for use. Release files contain Active and Inactive components to provide a historical record of the content of the terminology at different points in time.

Note: A component is active when the most recent row with the relevant Component.id in the Full Release of the relevant Release File has the value Component.active=1 (one). The most recent row for a component is determined based on the Component.effectiveTime value.

Affiliate

An IHTSDO Affiliate Licensee in accordance with the IHTSDO Affiliate Licence Agreement.

Alternatives

IHTSDO Affiliate
Affiliate Licensee

Affiliate Licence Agreement

The agreement between an IHTSDO affiliate (the licensee) and the IHTSDO (the licensor) under which developers and implementers are permitted to use the SNOMED CT International Release and distribute it to their sub-licensees as part of a software system.
Alternatives
Affiliate Licence

ANSI
American National Standards Institute (ANSI) is a private non-profit organisation that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organisation also coordinates U.S. standards with international standards.

Alternatives
ANSI
American National Standards Institute

Application Programming Interface
Application Programming Interface
A set of rules and specifications that enable communication between software programs. Application Programming Interfaces enables interaction between separate software programs, in much the same way that a user interface facilitates interaction between humans and computers.

Alternatives
API

Attribute
An attribute represents a characteristic of the meaning of a concept or the nature of a refinement.

Note: An attribute has a name which is represented by a concept. All the concepts that can be used to name attributes are subtypes of the concept | concept model attribute |. An attribute is assigned a value (attribute value pair) when used in the definition of a concept or in a postcoordinated expression. The permitted attribute values (range) for an attribute depend on the attribute name and on the domain of the concept being refined.

Example: 116676008 | Associated morphology |

Alternatives
Concept Model Attribute
Relationship Type
Role

Attribute group
An association between a set of attribute value pairs which causes them to be treated separately from other attribute value pairs in the same definition or postcoordinated expression refinement.

Example:
The definition of the concept |cholecystectomy with exploration of common duct| has two |method| attributes with different values (|excision -action| and |exploration -action|) and two |procedure site direct| attributes with different values (|common bile duct structure| and |gallbladder structure|). The attributes are grouped so that procedure is not incorrectly classified as an |excision of common bile duct|.

Alternatives
AttributeGroup

Attribute name
A concept that represents the type of a relationship or the type of a refinement in a postcoordinated expression.

Notes:
1. The type of a relationship is indicated by the typeId attribute in the Relationship file
2. The concepts that can be used to name attributes are:
Alternatives
Relationship Type
AttributeName

Attribute value
A concept that represents the target of a relationship or the value of an expression refinement in a postcoordinated expression.

Alternatives
Attribute-value
AttributeValue

Attribute value pair
A combination of an attribute name and an attribute value used to represent a specific type of information in a generic way without altering the underlying structure of an information model. The attribute name identifies the type of information and the attribute value provides a value.

Note: Attribute value pairs are used by SNOMED CT in relationships and postcoordinated expressions. In both cases, the attribute name and attribute value are expressed using SNOMED CT concept identifiers. In the Relationship file, the attribute name is represented by the Relationship.typeId and the attribute value by the Relationship.destinationId.

Authoritative concept
A concept with a specific meaning defined by an authoritative source such as a national or international professional body or standards organisation.

Authorized Triage Organization
An organisation approved by the IHTSDO to manage and triage change requests to for inclusion of content in the SNOMED CT International Release and/or one or more National Extensions.

Note: IHTSDO Members and their National Release Centers are likely to fulfil this role. In addition, IHTSDO affiliates and Standards Development Organisations may be eligible for consideration as Authorized Triage Organizations.

Alternatives
ATO

Automatic classification
A process that generated a logically consistent subtype classification by applying description logic rules to the stated definitions of a set of concepts.

Alternatives
Auto classify

Baseline
A release status applied to a collection of SNOMED CT release files that represent the first formally endorsed release of additions of components and/or derivatives to the SNOMED CT International Release or to a SNOMED CT Extension. The Baseline status indicates the releasing party (IHTSDO or the owner of the Extension) commits to maintain the release history of this release and all subsequent updates. Once confirmed as a Baseline, additional components and derivatives will be maintained and
versioned in accordance with the Release Format 2 specification (i.e. by adding rows to the Full Release with the effectiveTime appropriate to the update).

Note: The significance the Baseline status is that implementers can use the additional components and derivatives in operational systems, with confidence in the subsequent maintenance of these additions.

Browser

A computer application or software tool used for exploring and searching terminology content. A typical SNOMED CT browser can locate concepts and descriptions by Identifiers and by searching the text of description terms. Various views of located concepts may be displayed including the set of related descriptions, the hierarchical relationships and other defining relationships.

Alternatives

SNOMED CT browser

Candidate Baseline

A provisional status applied to a collection of SNOMED CT release files that represent a proposed additions of components and/or derivatives to the SNOMED CT International Release or to a SNOMED CT Extension. The Candidate Baseline status indicates the releasing party (IHTSDO or the owner of the Extension) expects to subsequently confirm the release as the Baseline. However, if a significant issue is reported in its format or content, the releasing party reserves the right to withdraw a Candidate Baseline release, or to replace it with another Candidate Baseline, to address the issue. The releasing party need not commit to this being an actual Baseline release until shortly before the due date for the next release.

Note: The significance the Candidate Baseline status is that anyone implementing this data must be prepared for withdrawal or significant changes that may occur to the additional components or derivatives. Therefore, this data should not be used in an operational environment in ways that create a dependency on continued maintenance of the additional components or derivatives. However, a Candidate Baseline may be confirmed as the Baseline and, in that case all subsequent updates to the additional components and derivatives will be fully version tracked from the release of the Candidate Baseline.

Canonical form

An serialised representation of a SNOMED CT expression which follows the normal form and in which the refinements, attributes and attribute groups are arranged in a standard order.

Cardinality

A measure of the number of elements in a set. Modelling rules include constraints on the cardinality of particular attributes or associations between classes.

CEN

The European Committee for Standardisation is a major provider of European Standards and technical specifications. Its mission is to foster the European economy in global trading, the welfare of European citizens and the environment. Through its services it provides a platform for the development of European Standards and other technical specifications.

Alternatives

Comité Européen de Normalisation
European Committee for Standardization
Europäisches Komitee für Normung

© 2002-2015 International Health Terminology Standards Development Organisation CVR #: 30363434
CEN TC251

CEN/TC 251 (CEN Technical Committee 251) is a committee within the European Committee for Standardisation (CEN) working on standardisation in the field of Health Information and Communications Technology (ICT) in the European Union. Its goal is to achieve compatibility and interoperability between independent systems and to enable modularity in Electronic Health Record systems.

Check digit

The check-digit is the final (rightmost) digit of the SNOMED CT Identifier (SCTID). It can be used to check the validity of SCTIDs. Clinical Information Systems can use the check-digit to identify SNOMED CT codes that have been entered incorrectly (typo errors, etc). It is calculated using the Verhoeff algorithm.

Clinical Information System

A computer-based system that is designed for collecting, storing, manipulating and making available clinical information to support the delivery of healthcare services to individual people and populations.

Alternatives

CIS

Clinical Terms Version 3

One of the source terminologies, along with SNOMED RT, that were used to develop SNOMED CT. CTV3 is UK Crown Copyright, distributed by the United Kingdom National Health Service (NHS), and is integrated into SNOMED CT.

Alternatives

CTV3
Version 3 of the Read Codes

C-NPU

Nomenclature, Properties and Units (C-NPU) in collaboration with International Union of Pure and Applied Chemistry (IUPAC) The IFCC-IUPAC coding system Provides a terminology for Properties and Units in the Clinical Laboratory Sciences

Alternatives

Nomenclature, Properties and Units
NPU
IFCC IUPAC

Note: The name of the organisation responsible for C-NPU sometimes used as a synonym

Collaborative Space

A web resource with software to help people involved in a common task achieve goals by enabling effective communication within a project or organisation.

Note: The IHTSDO Collaborative Space supports the communication needs of IHTSDO governance and advisory bodies. IHTSDO Standing Committees, Affiliate Forum, Member Forum and Working Groups all have Collaborative Space Projects each of which contain meeting announcements, discussions, shared documents and issue trackers.

Alternatives

Collabnet

Common Terminology Services 2

An Application Programming Interface (API) specification that is intended to describe the basic functionality that needed by healthcare software implementations to query and access terminological content. CTS2 defines the functional requirements of a set of service interfaces to allow the representation, access, and maintenance of terminology content either locally, or across a federation of terminology service nodes.
Note: CTS2 is specified as an API rather than a set of data structures to enable a wide variety of terminological content to be integrated within a common framework without the need for significant migration or rewrite.

Note: CTS2 was developed from the original the [see HL7 CTS specification] and is now a joint initiative between HL7 and the [see Object Management Group (OMG)].

Alternatives

CTS2
HL7 CTS2

Complement

In set theory the complement of set A relative to the universal set U is the set of all members of U that are not members of A.

Note: Set theory is applied when describing the intended result of combinations of Reference Sets or Constraints.

SNOMED CT Component

Refers to any item identified by an SCTID in the main body of SNOMED CT, or in an authorised Extension. The partition-identifier indicates the type of component referred to by that SCTID. Each component is a uniquely identifiable instance of one of the following:

• Concept
• Description
• Relationship

Alternatives

Component

Component history

A record of an addition or change in the status of a SNOMED CT Component in a particular Release Version.

Compositional grammar

The set of rules that govern the way in which SNOMED CT expressions are represented as a plain text string.

Note: The specification of the [see SNOMED CT Compositional Grammar] is available as part of the Technical Implementation Guide.

Alternatives

SNOMED CT compositional grammar

Concept

A clinical idea to which a unique Concept Identifier has been assigned.

The term concept may also be used informally with the following meanings:

• The concept Identifier, which is the key of the Concept file (in this case it is less ambiguous to use the term "conceptId" or "concept code");
• The real-world referent(s) of the Concept Identifier, that is, the class of entities in reality that the Concept Identifier represents (in this case it is less ambiguous to use the term "meaning" or "code meaning").

Alternatives

SNOMED CT concept

Concept enumeration

Use of SNOMED CT concept Identifiers to represent of a set of values for a property of a particular type of SNOMED CT component.
Note: The **SNOMED CT concepts** used to represent **concept enumerations** are usually **subtype children** (or **descendants**) of a relevant general **concept** in the **SNOMED CT** metadata hierarchy. Each possible value is represented by a single child **concept**, and the set of values can be used to enable selection from a pick-list of one or more **concepts**.

Example:

- 900000000000446008 | Description type (core metadata concept) |
- 900000000000003001 | Fully specified name (core metadata concept) |
- 900000000000013009 | Synonym (core metadata concept) |
- 900000000000550004 | Definition (core metadata concept) |

**Figure 138: Concept enumeration for: Description.typeId**

**Concept equivalence**

*Equivalence* is the state of two **SNOMED CT concept** codes or **postcoordinated expressions** having the same meaning. **Concept equivalence** can occur when a **postcoordinated expression** has the same meaning as a **precoordinated concept** code; or when two different **postcoordinated expressions** have the same meaning.

**Concept Identifier**

A **SNOMED CT Identifier** that uniquely identifies a **Concept** (meaning).

Example: For the meaning named | Pneumonia (disorder) |, the **Concept Identifier** is 233604007.

**Concept model**

A set of rules that determines the permitted sets of **Relationships** between particular types of **concept**. The **Concept Model** specifies the attributes that can be applied to particular **concepts** and the ranges of permitted values for each of these attributes. There are also additional rules on the **cardinality** and grouping of particular types of **Relationships**.

Note: The [see **Concept Model Guide (6)**](#) (which is part of the Technical Implementation Guide) summarises the current set of rules applied to modelling **SNOMED CT concepts**. More detailed information, aimed at those involved creating and modelling content, is available in the **SNOMED CT Editorial Guide**.

**Constraint**

A rule that specifies limits on the attributes, values and associations that may be applied to a particular component.

Examples:

1. A modelling constraint may limit the permissible defining **Relationships** applied to a particular type of **concept**.
2. An instance data constraint may limit the permissible refinements that may be applied to particular **concept**

**Context domain**

A **context domain** is a set of values that are, or may be, used in an identifiable logical setting in an application, protocol, query or communication specification. A context domain may be very broad (e.g. procedures or diagnoses) or very narrow (e.g. procedures performed by a specialty or possible values for a field in specific message).

**Context specific characteristic**
A Relationship to a target Concept that provides information about the source Concept that is true at a particular time or within a particular country or organisation. Contrast with Defining characteristic and Qualifying characteristic. Referred to in CTV3 as a ‘Fact’.

Context wrapper
The part of a SNOMED CT expression that specifies the context that applies to the focus concept that it contains.

Example: “Family history of asthma” can be represented by an expression in which the concept “asthma” is nested within an context wrapper that indicates that this is “family history” - rather than a current condition affecting the patient. For further details see [see Modeling semantic context].

Core file
A distribution file used to represent the main SNOMED CT components (concepts, descriptions and relationships).

Note: In the past the term “core” has also been used to refer to the content of the SNOMED CT International Release but this usage is deprecated.

Alternatives
SNOMED CT core
Core table
SNOMED CT core table
SNOMED CT core file
Core table

D

Darwin Information Typing Architecture
The Darwin Information Typing Architecture (DITA) is an XML-based architecture for authoring, producing, and delivering information. Although its main applications have so far been in technical publications, DITA is also used for other types of documents such as policies and procedures.

Note: DITA is used for creation, publication and maintenance of many IHTSDO guidance documents.

Alternatives
DITA

Data Analysis System
A computer system that is used to analyse records or other data that is encoded using SNOMED CT, but not if that system is also a Data Creation System;

Note: IHTSDO charges fees for use of Data Analysis Systems and Data Creation Systems in Non-Member Territories.

Data Creation System
A computer system that is used to create records or other data that is encoded using SNOMED CT.

Note: IHTSDO charges fees for use of Data Analysis Systems and Data Creation Systems in Non-Member Territories.

Data migration
Steps taken to enable legacy data to be accessible as part of a system that uses SNOMED CT.

**Note:** The objective of data migration is to enable data recorded prior to introduction of SNOMED CT can be retrieved and reused within a SNOMED CT enabled application. Options for data migration include actual conversion of the data or provision of methods for accessing the data in its original form.

### Defining relationship

A relationship to a target concept that is always necessarily true from any instance of the source concept.

**Example:** The defining relationships of the concept | gastrectomy | include | method|=| excision - action| and | procedure site - Direct|=| stomach structure|.

### Delta release

A Release Type in which the release files contain only component versions created since the previous release. Each component version in a delta release represents either a new component or a change to an existing component.

### SNOMED CT Derivative

A document, subset, set of maps, or other resource that consists of, includes, references or is derived from one or more SNOMED CT components. The standard computer processable representation for most types of SNOMED CT derivatives is a Reference set.

### Description

An association between a human-readable phrase (term) and a particular SNOMED CT concept code. Each description is represented by a separate row in the Description file.

**Note:** Each description has a unique identifier and connects concept with a term of a specified description type.

### Description Identifier

A SNOMED CT Identifier that uniquely identifies a Description.

### Description logic

A representation of semantic knowledge that allows formal reasoning to be applied based on axioms that state relationships between concepts.

**Note:** Description logic definitions of SNOMED CT concepts are represented by defining relationships. The formal rules of description logic can be applied to defining relationships by software tools (description logic classifiers) to interpret the meaning of concepts. This enables confirmation of the logical integrity of the terminology, and can also be used to support meaning-based retrieval from SNOMED CT enabled record systems.

### Related Links

*Wikipedia entry on Description logic*
A software tool that applies the rules of a description logic to a set of data to make inferences about the relationships between sets of concepts.

**Note:** SNOMED CT concepts and relationships are processed by a description logic classifier to generate the subtype hierarchy. SNOMED CT expressions can also be processed by a classifier to make inferences that support selective retrieval.

**Alternatives**

**Classifier**

**Description Type**

An indication of the intended usage of the term of a SNOMED CT description when applied to the associated concept.

**Notes:**

1. The description type is represented by the value of the description.typeId attribute.
2. Permitted values include the following (other types may be defined in future):

**Table 311: Description types**

<table>
<thead>
<tr>
<th>typeId (with term)</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>900000000000003001</td>
<td>Fully specified name</td>
</tr>
<tr>
<td>900000000000013009</td>
<td>Synonym</td>
</tr>
<tr>
<td>9000000000000550004</td>
<td>Definition</td>
</tr>
</tbody>
</table>

3. The preferred term is the synonym marked as preferred for use in the Language reference set for a given language or dialect (it is not a distinct description type).

**Dialect**

A language modified by the vocabulary and grammatical conventions applied to the language of a particular geographical or cultural environment.

**Directed Acyclic Graph**

A set of nodes connected to one another by lines (edges) in which each connection has a specified direction such that no route that follows the direction of the connections enters a loop (cycle).

**Example:** The SNOMED CT subtype hierarchy is an example of a Directed Acyclic Graph. SNOMED CT concepts are nodes and "is a" Relationships are the directed lines that connect them. All "is a" Relationships lead from a more specific concept to a more general concept, so a cycle would be a logical error (e.g. if "rubella virus" is a type of "virus" and "virus" is a type of "microorganism", then "microorganism" cannot be a type of "rubella virus").

**Alternatives**

DAG

**Domain**

A set of concepts which the Concept Model permits to be defined or refined using a particular set of attributes and ranges.
Note: A domain to which an attribute can be applied is typically defined to include concepts in one or more branches of the subtype hierarchy.

Example: The domain of the attribute 116676008 | Associated morphology | is defined as subtype of 404684003 | Clinical finding | hierarchy. Similarly, the range for values of 116676008 | Associated morphology | is subtypes of 49755003 | Morphologically abnormal structure |.

Alternatives
Concept model domain

Draft Standard for Trial Use
A Draft Standard for Trial Use is a specification and process to allow implementers to test a standard. At the end of the trial period the standard may be balloted, revised or withdrawn.

Example: The joint project between HL7 International and the IHTSDO, TermInfo, is an example of an HL7 DSTU.

Alternatives
DSTU

Duplicate term
A Term that occurs in several Active Descriptions. Duplicate Terms are valid in SNOMED CT since the intention is to provide natural terms used by clinicians rather than to apply formalised phraseology. The formalised form is provided by the Fully Specified Name and these are not permitted to be duplicated.

Dynamic snapshot view
A "snapshot view" for a specified date that is generated by filtering a "full view".

Electronic health record
A systematic collection of health information about individual patients or populations that is stored in a digital form. An Electronic health record may contain a complete and detailed record of a patient's health or may consist of a summary of information of particular relevance to continuing delivery of care.

Alternatives
EHR

EN13606
Electronic Health Record Communication (EN 13606) European Standard developed by CEN TC251 to define a rigorous and stable information architecture for communicating part or all of the Electronic Health Record (EHR) of a single subject of care (patient). This is to support the interoperability of systems and components that need to communicate (access, transfer, add or modify) EHR data via electronic messages or as distributed objects:

• preserving the original clinical meaning intended by the author;
• reflecting the confidentiality of that data as intended by the author and patient.

Enabled application
A software application designed to support the use of SNOMED CT.
Alternatives
SNOMED CT enabled application
SNOMED enabled application
SNOMED CT application
SNOMED application

Enabled implementation
Implementation of information systems that are able to make effective use of SNOMED CT in an organisation or region.

Note:  SNOMED CT enabled implementation has a broader meaning than SNOMED CT enabled application. An implementation involves practical deployment of one or more applications but extends beyond the software itself to address personnel and organisational issues that allow the potential benefits to be realised.

Alternatives
SNOMED CT enabled implementation
SNOMED enabled implementation
SNOMED CT implementation
SNOMED implementation

Equivalence
See Word Equivalents, Phrase equivalence and Concept equivalence.

Expression
A structured combination of one or more concept identifiers used to express a clinical idea.

Note:
An expression containing a single concept identifier is referred to as a precoordinated expression. An expression that contains two or more concept identifiers is a postcoordinated expression.

The concept identifiers in a postcoordinated expression are related to one another in accordance with rules expressed in the SNOMED CT Concept Model.

These rules allow an expression to refine the meaning of a concept by applying more specific values to particular attributes of a more general concept.

Example:
284196006 | burn of skin | : 363698007 | finding site | = 33712006 | skin of hand |

Alternatives
SNOMED CT expression

Expression refinement
The part of a SNOMED CT expression that applies qualifying details to a focus concept.

Example: A "spiral fracture of the left humerus" can be represented by an expression in which the concept "fracture of humerus" if made more specific by the addition of two refinements "laterality: left" and "associated morphology: spiral fracture".

Alternatives
Refinement

Extension namespace identifier
See namespace identifier.

F

Focus concept
The part of a SNOMED CT expression that represents a clinical finding, observation, event or procedure. This focus concept may be given context by a surrounding content wrapped and may be made more specific by a refinement.

**Example:** A past history of replacement of the left hip may be represented by a SNOMED CT expression in which the focus concept “hip replacement” is refined by “laterality: left” and enclosed in a context wrapper representing “past history”.

**Full release**

A Release Type in which the release files contain every version of every component ever released.

**Full view**

A view of SNOMED CT that includes all the components in a Full release. This includes the full history or all components ever released. A Full view can be filtered to provide a Dynamic snapshot view of the components as they were at any point in the past.

**Fully Specified Name**

A term unique among active descriptions in SNOMED CT that names the meaning of a concept code in a manner that is intended to be unambiguous and stable across multiple contexts.

**Notes:**

1. Fully specified names are indicated with the typeld 900000000000003001 | Fully specified name |.
2. There may be more than one active description with the typeld 900000000000003001 | Fully specified name |. However, only one fully specified name should be marked as preferred for use in a given language or dialect in the relevant Language reference set.
3. The US English fully specified name is the point of reference for the meaning of all concepts in the SNOMED CT International Edition. However, where a concept is part of an extension the fully specified name specified in the original language of that extension applies.

**Alternatives**

FSN

**Health Level 7**

A not-for-profit, ANSI-accredited standards developing organisation dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practise and the management, delivery and evaluation of health services.

**Alternatives**

HL7

**Health Level 7 Version 3**

A standard for communication of health care information developed by HL7. Version 3 is based on a formal development framework and its communication structures are derived as refinements from a Reference Information Model (HL7 V3 RIM).

**Alternatives**

HL7 V3

**Health Level 7 Version 3 Reference Information Model**

The reference information model on which HL7 Version 3 is based.
Alternatives
HL7 V3 RIM

Hierarchy
An ordered organisation of concept codes linked together through is a relationships. Concept codes linked to their more general parent concept codes directly above them in a hierarchy. Concept codes with more general meanings are usually presented as being at the top of the hierarchy and then at each level down the hierarchy code meanings become increasingly more specific or specialised. Formally, a hierarchy is represented as a Directed Acyclic Graph.

HL7 TermInfo
An HL7 project that developed the ’HL7 Version 3 Implementation Guide: Using SNOMED CT as a Draft Standard for Trial Use’ (DSTU). The purpose of this guide is to ensure that HL7 Version 3 standards achieve their stated goal of semantic interoperability when used to communicate clinical information that is represented using concepts from SNOMED CT.

Alternatives
Term Info

ICD-10
The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) is a coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization (WHO).

ICD-9
The International Statistical Classification of Diseases and Related Health Problems 9th Revision (ICD-9) is a coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization (WHO).

Note: Replaced by ICD-10.

ICD-9-CM
The International Classification of Diseases, 9th Revision, Clinical Modification” (ICD-9-CM), Sixth Edition, issued for use beginning October 1, 2008 for federal fiscal year 2009 (FY09). The ICD-9-CM is maintained jointly by the National Centre for Health Statistics (NCHS) and the Centres for Medicare & Medicaid Services (CMS).

IFCC IUPAC
Nomenclature, Properties and Units (C-NPU) in collaboration with International Union of Pure and Applied Chemistry (IUPAC). The IFCC-IUPAC coding system provides a terminology for Properties and Units in the Clinical Laboratory Sciences.

Inactive component
A SNOMED CT component that is not intended for use. Active and Inactive components are included in release files to provide a historical record of the content of the terminology different points in time.

Note: A component is inactive when the most recent row with the relevant Component.id in the Full Release of the relevant Release File has the value Component.active=0 (zero). The most recent row for a component is determined based on the Component.effectiveTime value.

Alternatives
Inactive

Inactive concept
A Concept that is not intended for use. Release files contain Active and Inactive components to provide a historical record of the content of the terminology at different points in time.

Note: A component is inactive when the most recent row with the relevant Component.id in the Full Release of the relevant Release File has the value Component.active=0 (one). The most recent row for a component is determined based on the Component.effectiveTime value.

Inactive description
A Description that is not intended for use. Release files contain Active and Inactive components to provide a historical record of the content of the terminology at different points in time.

Note: A component is inactive when the most recent row with the relevant Component.id in the Full Release of the relevant Release File has the value Component.active=0 (one). The most recent row for a component is determined based on the Component.effectiveTime value.

Intellectual property rights
As defined in the IHTSDO affiliate Licence Agreement: patents, trade marks, service marks, copyright (including rights in computer software), moral rights, database rights, rights in designs, trade secrets, know-how and other intellectual property rights, in each case whether registered or unregistered and including applications for registration, and all rights or forms of protection having equivalent or similar effect in any jurisdiction.

Note: The IHTSDO owns the intellectual property rights of SNOMED CT. The IHTSDO is responsible for ongoing maintenance, development, quality assurance, and distribution of SNOMED CT.

Alternatives
IPR
Intellectual Property
IP

International Health Terminology Standards Development Organisation
The International Health Terminology Standards Development Organisation (IHTSDO) is a not-for-profit association that develops and promotes use of SNOMED CT to support safe and effective health information exchange.

Alternatives
IHTSDO

Intersection
In set theory the intersection of the sets A and B, is the set of all objects that are members of both A and B.

Note: Set theory is applied when describing the intended result of combinations of Reference Sets or Constraints.

IS A
The RelationshipType that defines a supertype - subtype. Relationship between two Concepts. Usually expressed as subtype | is a | supertype. For Example, Blister with infection | is a | Infection of skin.

ISO
ISO (International Organisation for Standardisation) is the world's largest developer and publisher of International Standards. ISO is a network of the national standards institutes from over 160
countries, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system.

**ISO TC215**

ISO TC215 is the ISO Technical Committee for Standardisation in the field of information for health, and Health Information and Communications Technology (ICT). Its objectives are to enable compatibility and interoperability between independent systems, to ensure compatibility of data for comparative statistical purposes (e.g. classifications), and to reduce duplication of effort and redundancies.

**K**

**Kind of value**

The nature of a value that may be associated with a Concept. For example, the concept | systolic blood pressure | can label a numeric value. The Kind-of-Value that it labels is a pressure.

**L**

**Language**

For purposes of SNOMED CT translations, a language is a vocabulary and grammatical form that has been allocated an ISO639-1 language code. See also dialect.

**LOINC**

Logical Observation Identifiers Names and Codes, a dataset of universal identifiers for identifying medical laboratory observations and other clinical observations to facilitate exchange and storage of clinical results or vital signs.

**Alternatives**

Logical Observation Identifiers Names and Codes

**M**

**Machine readable concept model**

A representation of the rules that comprise the SNOMED CT Concept Model in a form that can be processed by computer software and applied to validate content.

**Note:** The Machine readable concept model can be applied to support consistent authoring of SNOMED CT content and can also support the creation of valid postcoordinated expressions in instance data.

**Alternatives**

MRCM

**Managed content addition**

An implementation strategy that involves creating additional concepts, Descriptions and Relationships in an extension so that data can be recorded to the required level of detail using only precoordinated expressions.

**Note:** A description logic classifier can be used to obtain an updated inferred view of the whole terminology in order to support data retrieval.

**Alternatives**
MCA

Mapping
The process of converting data from a representation in one code system, classification or terminology so that it is represented in another code system, classification or terminology.

Note:
The process as a whole includes the preparation and maintenance of resources used to enable this conversion and the application of such resources to convert instance data.

In SNOMED CT Mapping resources are distributed as [see Simple] and [see Complex and Extended Map Reference Sets].

Alternatives
Cross Mapping

Member
A Member of the International Health Terminology Standards Development Organisation (IHTSDO) in accordance with the IHTSDO Articles of Association.

Alternatives
IHTSDO member

Member territory
A territory that is represented by an IHTSDO Member (as published by the Licensor from time to time)

Metadata
SNOMED CT content (including concepts, Descriptions and Relationships) that is used to describe or provide additional information about SNOMED content and derivatives (including reference sets).

Note:
All SNOMED CT metadata concepts are subtypes of 90000000000441003 | SNOMED CT Model Component (metadata) |. The top level of the metadata hierarchy represent broad groups of metadata as shown below.

- 90000000000441003 | SNOMED CT Model Component (metadata) |
  - 106237007 | Linkage concept (linkage concept) |
  - 370136006 | Namespace concept (namespace concept) |
  - 90000000000442005 | Core metadata concept (core metadata concept) |
  - 90000000000454005 | Foundation metadata concept (foundation metadata concept) |

Figure 139: Top level of the SNOMED CT metadata hierarchy

Alternatives
SNOMED CT Metadata

Migration
See Operational migration, Data migration and Predicate migration.

Model of meaning
An information model that is structured in a way that is designed to provide a common representation of particular types of information which is reusable between different use cases. A model of a meaning combines structural and terminological component in ways that avoid ambiguity and minimise alternative representations of similar meanings.
Example: A model that specifies how *SNOMED CT expressions* are used to represent in a particular *reference information model* to represent clinical findings and procedures in an *electronic health record*.

Note: In contrast, a *model of use* represents the underlying meaning in a way that is determined by a limited set use cases.

**Model of use**

An information model that is structured in a way suggested by a particular intended use of the information that will be represented by that model.

Example: A database that is structured with tables and fields that match specific *user interface forms* and the data entry box on those forms.

Note: In contrast, a *model of meaning* represents the underlying meaning in a way that is common to and reusable between different use cases.

**Modeler**

A person who directly edits the logic definitions and other structures of the terminology. Also sometimes called Clinical Editor or Terminology Manager.

**Modeling**

The process of editing logic definitions to reflect the meaning intended by the *Fully Specified Name*.

**Monohierarchy**

A *Monohierarchy* is a hierarchy in which each node is linked to one and only one parent node.

This type of hierarchy can be represented as a tree with a single root to which each node is attached.

**Moved elsewhere**

A *Status value* applicable to a *component* that has been moved to another *Namespace*. *Concepts* or *Descriptions* may be moved from an *Extension* to the *International Release*, from the *International Release* to an *Extension* or between one *Extension* and another. Moves occur if responsibility for supporting the *Concepts* changes to another organisation.

Note: Component status value

**Namespace concept**
A Concept that exists to represent a SNOMED CT Namespace-Identifier. All Namespace Concepts are direct subtypes of the Concept "Namespace Concept which is a subtype of the Top-Level Concept "Special Concept ".

### Namespace identifier

A seven digit number allocated by the IHTSDO to an organisation that is permitted to maintain a SNOMED CT Extension. The namespace identifier forms part of the SCTID allocated every component that originated as part of an Extension. Therefore, it prevents collision between SCTIDs issued by different organisations. The namespace-identifier indicates the provenance of each SNOMED CT component.

**Note:** Short format SCTIDs, which are used for components that originate in the International Release, do not include a namespace-identifier. In this case the partition identifier provides sufficient information about the origin of the component.

#### Alternatives
- Extension namespace identifiers
- Namespaceld

### National Health Service

Located in the United Kingdom, the National Health Service (NHS) worked with the College of American Pathologists in the development of SNOMED CT. The NHS is was one of the founder Members of the IHTSDO that is now responsible for SNOMED CT.

#### Alternatives
- UK National Health Service
- UK NHS
- NHS

### National Library of Medicine

The National Library of Medicine (NLM, in Bethesda, Maryland, is a part of the National Institutes of Health, US Department of Health and Human Services (HHS). NLM is the world's largest medical library. The NLM represents the US, as a founder Member of the IHTSDO.

#### Alternatives
- NLM

### National Release Center

The organisation within an IHTSDO Member country that is responsible for maintaining and releasing SNOMED CT content including any National Extensions of SNOMED CT.

### Natural language processing

Natural Language processing (NLP) is concerned with the interactions between computers and human-readable languages. NLP includes understanding and generation of human-readable representations. NLP understanding systems convert human-readable text into formal representations, which may for example include SNOMED CT expressions, to enable more effective processing by other software. NLP generation systems convert information from formal representations into human-readable text.

#### Alternatives
- NLP

### Navigation

The process of locating a Concept by traversing Relationships or Navigation links. For example, moving from a supertype Concept to more refined Concepts, from a specific Concept to a more general Concept or from a Concept to its Defining characteristics. Navigation Links allow navigation to follow intuitive routes through SNOMED CT even where there are no direct supertype or subtype Relationships.

### Navigation concept

A Concept that exists only to support Navigation. A Navigation Concept is not suitable for recording or aggregating information. All Navigation Concepts:
- Are direct subtypes of the concept "Navigational Concept";
- Have not other supertype or subtype Relationships
- Are linked to other Concepts only by Navigational Links.

**Navigation Hierarchy**

A hierarchical view of a set of SNOMED CT concepts that is intended to assist navigation at the user interface.

- **Note:** There are several differences between navigation hierarchies and the formal subtype hierarchy:
  1. Links between concepts in a navigation hierarchy are represented by an [see Ordered Reference Set]
  2. Navigation links do not contribute to the semantic definitions of concepts. Therefore, the criteria for creating a navigation hierarchy can be based on arbitrary criteria relating to usability;
  3. A navigation hierarchy may specify the order in which a set of concepts are to be displayed when nested under another specified concept.

**Non-member territory**

A territory that is not an IHTSDO Member Territory

- **Note:** In accordance with IHTSDO affiliate Licence, fees are payable to the IHTSDO for use of SNOMED CT in non-Member Territories.

**Normal form**

A representation of a SNOMED CT expression in which none of the referenced concepts are fully defined and where there is no redundancy or duplication of meaning.

- **Notes:**
  1. Normal forms can be used to determine equivalence and subsumption between expressions and thus assist with selective retrieval.
  2. Any SNOMED CT expression can be transformed to its normal form by replacing each reference to a fully defined concept with a nested expression representing the definition of that concept. Transformation rules then resolve redundancies, which may arise from expanding fully defined concepts, by removing less specific attribute values.

**Normal form transformation**

The process of converting a SNOMED CT expression into its normal form.

- **Notes:**
  1. The normal form provides a way compare different expressions which have a similar meaning.
  2. The transformation rules are described in [see Transforming expressions to normal forms].

**Alternatives**

Transform
Transformation

**openEHR**

openEHR is an international not-for-profit Foundation working towards making the interoperable, life-long electronic health record a reality and improving health care in the information...
society. It develops specifications that are primarily based on and extend key aspects of the CEN Standard for Electronic Health Record Communication (EN 13606).

Operational migration

Steps taken to enable an organisation that either used a previous coding scheme (or no clinical coding scheme) to make use of SNOMED CT.

Partition-identifier

The second and third digits from the right of the string rendering of the SCTID. The value of the partition-identifier indicates the type of component that the SCTID identifies (e.g. Concept, Description, Relationship, etc) and also indicates whether the SCTID contains a namespace identifier.

Alternatives

PartitionId

Pending move

A Status value applicable to a component that is thought to belong in a different Namespace but which is maintained with its current SCTID while awaiting addition to the new Namespace. A new Concept and associated Descriptions may be added with this Status where a missing SNOMED CT Concept is urgently required to support the needs of a particular Extension. Existing Concepts are also given this status when it is recognised that they should be moved to a different Extension or to the International Release. See also Moved elsewhere.

Note: Component status value.

Phrase equivalence

Two words or phrases with a similar meaning. For example, "renal calculus" and "kidney stone". See Word Equivalents.

Polyhierarchy

A Polyhierarchy is a hierarchy in which each node has one or more parents.

This type of hierarchy can be represented as a graph in which each node has one or more directed links to or from other nodes. Since a node in a hierarchy cannot be a descendant of itself the resulting graph must not contain cyclic Relationships. This type of graphs is referred to as a "Directed Acyclic Graph".

Alternatives

Polyhierarchical classification

Postcoordinated expression

Representation of a clinical meaning using a combination of two or more concept identifiers is referred to as postcoordination.

Note: Some clinical meanings may be represented in several different ways. SNOMED CT technical specifications include guidance for transforming logical expressions to a common canonical form.

Example: SNOMED CT includes the following concepts:

125605004 | fracture of bone |
363698007 | finding site |
71341001 | bone structure of femur |

SNOMED CT also includes a precoordinated concept for 71620000 | fracture of femur |. Therefore it is possible to represent the clinical meaning "fracture of femur" in different ways:
• as a precoordinated expression:
  • 71620000 | fracture of femur |

• or as a postcoordinated expression:
  • 125605004 | fracture of bone | : 363698007 | finding site | = 71341001 | bone structure of femur |

**Alternatives**
- Precoordinated
- Postcoordinated

### Precoordinated expression

Representation of a clinical meaning using a single concept identifier is referred to as a precoordinated expression.

**Note:** In contrast, expressions that contain two or more concepts identifier are referred to as postcoordinated expressions. For more information and examples see the glossary entry for postcoordinated expression.

**Alternatives**
- precoordinated expression
- Precoordinated
- Precoordination

### Predicate migration

Steps taken to enable pre-existing data retrieval predicates (including queries, standard reports and decision support protocols) to be converted or utilised in a system using SNOMED CT.

### Preferred term

The term that is deemed to be the most clinically appropriate way of expressing a Concept in a clinical record. The Preferred Term varies according to language and dialect.

**Note:** In Release Format 2 the Preferred Term is indicated by the acceptabilityId field of a Language Refset.

**Note:** In Release Format 1 the Preferred Term is indicated by a Language Subset and/or the DescriptionType field of the Description file.

### Primitive concept

A concept with a formal logic definition that is not sufficient to distinguish its meaning from other similar concepts.

**Note:**

The meaning of SNOMED CT concept is expressed in a human-readable form by its Fully Specified Name. Each concept also has a formal logic definition represented by a set of defining relationships to other concepts. This logic definition is computer processable. A primitive concept does not have sufficient defining relationships to computably distinguish them from more general concepts (supertypes).

See also sufficiently defined concept.

**Example:** The concept 5596004|atypical appendicitis (disorder)| is primitive because the following definition is not sufficient to distinguish "atypical appendicitis" from any other type of "appendicitis".

- 116680003 | is a | = 74400008 | appendicitis |
- 116676008 | associated morphology | = 23583003 | inflammation |
- 363698007 | finding site | = 66754008 | appendix structure |

**Figure 140:** Definition of: |atypical appendicitis (disorder)| (primitive)
Qualifying characteristic

An attribute-value relationship associated with a concept code to indicate to users that it may be applied to refine the meaning of the code. The set of qualifying relationships provide syntactically correct values that can be presented to a user for postcoordination. Example: 'Revision status' = 'First revision' is a possible qualifying characteristic of 'Hip replacement'. A qualifying characteristic is contrasted with a defining characteristic. It is referred to in CTV3 as a 'Qualifier.

Alternatives
Qualifier

Quality characteristic

A type of attribute of a component by which its quality is assessed or measured.

Note: The set of IHTSDO quality characteristics are a typology of attributes of an IHTSDO Component by which its quality is assessed or measured. A typology is the study or systematic classification of types that have attributes or traits in common.

Quality metric

An agreed method and means for measuring levels of achievement, performance or conformance of a component or its Quality characteristic(s).

Quality target

An agreed level of achievement, performance or conformance of a component for any given Quality characteristic.

Query predicate

A statement of a condition that determines whether candidate instance data should be included in or excluded from a selection.

Note: Query predicates applied to a set of SNOMED CT expressions may test for subsumption of the overall meaning and/or may test the values applied to particular attributes in the expression.

Range

A constrained set of values that the Concept Model permits to be applied to a specific attribute when that attribute is applied to a concept in a particular domain.

Note: The range of permitted values that can be applied to an attribute is typically defined to include concepts in one or more branches of the subtype hierarchy.

Example: The range for values of 116676008 | Associated morphology | is subtypes of 49755003 | Morphologically abnormal structure |.

Alternatives
Concept model range

Read Code

A five-character code allocated to a concept or term in CTV3. Note that codes allocated in Read Codes Version 2 and the Read Codes 4-Byte Set are also included in CTV3. The original 4-byte codes are distinguished from 5-byte codes in the general representation by prefixing them with a full stop.
Alternatives
Read Codes 4-Byte Set
Read Codes Version 2

Realm
A sphere of authority, expertise, or preference that influences the range of components required, or the frequency with which they are used. A Realm may be a nation, an organisation, a professional discipline, a specialty, or an individual user.

Record services
Functions performed by software that interacts with a record system used to capture information which may include references to information in a terminology.

Note: Record services are intimately related to ways in which information is entered, stored and retrieved by a particular application. These services interact with Terminology services but, unlike Terminology services they are usually specific to a particular application.

Reference information model
A high-level generalised model that allows information to be represented and related consistently within a particular field of human endeavour.

Note: The Health Level 7 Version 3 Reference Information Model is the most widely used reference information model in health care.

Reference set
A work consisting of a set of references to SNOMED CT components that may associate additional properties with components that are members of the set and/or which may indicate associations between members of the set or between members of the set and content of another nomenclature, classification or knowledge structure. The uses of Reference sets include identification of subsets of SNOMED CT content, representation of alternative hierarchical structures and maps to classifications.

Alternatives
SNOMED CT reference set
Refset

Reference set member
A uniquely identified row within the snapshot view of a reference set.

Note:
1. Different versions of a reference set member may share the same identifier (id) but have different effectiveTimes. This allows a reference set member to be modified or made inactive (i.e. removed from the active set) at a specified time.
2. Each reference set has an identifier (refsetId) and contains one or more reference set members. Each reference set member has its own unique identifier (id) which allows it to be versioned using the effectiveTime and active fields. All reference set members also contain a referencedComponentId (which refers to a component that is part of the set) and other fields that depend on the type of reference set.

Reference terminology
A terminology in which each term has a formal computer processable definition that supports meaning based retrieval and aggregation. SNOMED CT is a reference terminology

Relationship
An association between a source concept and a destination concept. The nature of the association is indicated by a reference to another concept referred to as the relationship type.
Notes:

1. Each relationship provides information about the source concept. In the example below
2. Relationships are represented by rows in the Relationship File

Example:

Table 312: Illustrative example of a Relationship

<table>
<thead>
<tr>
<th>source</th>
<th>type</th>
<th>destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>74400008</td>
<td>appendicitis</td>
<td>66754008</td>
</tr>
<tr>
<td>appendix</td>
<td>finding site</td>
<td>appendix structure</td>
</tr>
</tbody>
</table>

Alternatives

SNOMED CT relationship

SNOMED CT Release

The content of a version of a SNOMED CT Edition that has been made available to licensees at a particular point in time.

Release file

A computer file used to distribute SNOMED CT content from the IHTSDO (or from the originator of an Extension) in a form that can be readily imported by a software application.

SNOMED CT release files follow one of the release format specifications RF1 or RF2.

Alternatives

SNOMED CT release file
SNOMED CT distribution file

Release format

A file structure specified by the IHTSDO for files used to distribute SNOMED CT content.

Note: There are currently two release formats: Release Format 1 and Release Format 2.

Alternatives

SNOMED CT release format
SNOMED CT distribution format

Release Format 1

The file structure specified by the IHTSDO for the files used to distribute SNOMED CT content in 2002.

Note: This format was replace by Release Format 2 in January 2012, which is now the primary format for the SNOMED CT International Release. However, for backward compatibility Release Format 1 files can be generated using a conversion utility and continue to be distributed available during an interim transitional period.

Alternatives

SNOMED CT Release Format 1
RF1

Release Format 2

The file structure specified by the IHTSDO for files used to distribute SNOMED CT content from 2011.

Note: See also: Release Format 1.
Alternatives
SNOMED CT Release Format 2
RF2

Release Type
The temporal scope and completeness of a Release Format 2 file or set of files.

Table 313: SNOMED CT Release Types

<table>
<thead>
<tr>
<th>Release Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>The files representing each type of component contain every version of every component ever released.</td>
</tr>
<tr>
<td>Snapshot</td>
<td>The files representing each type of component contain one version of every component released up to the time of the snapshot. The version of each component contained in a snapshot is the most recent version of that component at the time of the snapshot.</td>
</tr>
<tr>
<td>Delta</td>
<td>The files representing each type of component contain only component versions created since the previous release. Each component version in a delta release represents either a new component or a change to an existing component.</td>
</tr>
</tbody>
</table>

Root concept
The single concept that is at the top of the SNOMED CT Concept hierarchy.

Root metadata concept
The single concept that is at the top of the SNOMED CT Model Component (metadata) hierarchy.

**Note:** Most of the data in the metadata hierarchy is only relevant to Release Format 2. Therefore, this concept may not be present in some Release Format 1 files.

Alternatives
Root metadata code

Situation with explicit context
A concept that specifically includes a definition the context of use of a clinical finding or procedure.

**Example:** "Family history of diabetes mellitus" is a situation with explicit concept because it defines the context as "family history". In contrast, "diabetes mellitus" is not a situation with explicit context because it can be used in many different situations including "family history", "past medical history", "current diagnosis", etc.
Note: A situation with explicit context is defined as a subtype of the situation to which it applies with an attribute associating it with the relevant clinical finding or procedure.

 Alternatives

Explicit context
Clinical situation

Snapshot release

A Release Type in which the release files contain one version of every component released up to the time of the snapshot. The version of each component contained in a snapshot is the most recent version of that component at the time of the snapshot.

Snapshot view

A view of SNOMED CT that includes all the components in the state there were in at a specified point in time. A Snapshot view be provided by a fixed representation that matches the content of a Snapshot release or may be generated as a Dynamic snapshot view by filtering a Full view.

SNOMED

An acronym for the Systematized Nomenclature of Medicine originally developed by the College of American Pathologists and now owned and maintained by the IHTSDO. SNOMED Clinical Terms is the most recent version of this terminology. It was preceded by SNOMED RT and SNOMED International.

SNOMED Clinical Terms

SNOMED CT is a clinical terminology maintained and distributed by the IHTSDO. It is considered to be the most comprehensive, multilingual healthcare terminology in the world. It was created as a result of the merger of SNOMED RT and NHS Clinical Terms Version 3.

 Alternatives

SNOMED CT Edition

The combination of a SNOMED CT Extension with the SNOMED CT International Edition and, where relevant, any module from other Extensions on which the SNOMED CT Extension depends.

Note: A SNOMED CT Edition may be released by the provider of the SNOMED CT Extension. However, in general a SNOMED CT Edition is derived by combining the SNOMED CT Extension release files with relevant release data from the SNOMED CT International Edition and any other Extensions on which it depends.

Alternatives

Edition

SNOMED CT Extension

A set of terminology components and derivatives that add to and are dependent on the SNOMED CT International Edition, and are created, structured, maintained and distributed in accordance with SNOMED CT specifications and guidelines.

Notes:

1. Components that are created in an extension are identified using extension SCTIDs. These identifiers include an extension namespace which ensures that they do not collide with other SCTIDs, and can be traced to an authorised originator.

2. Namespace identifiers are allocated in response to requests from IHTSDO Members and Affiliates. For further information about this process and for access to the current SNOMED CT Namespace Register please refer to the IHTSDO web page on Namespaces.

3. IHTSDO Members may create, maintain and distribute extensions to address specific national, regional and language requirements. IHTSDO Affiliates may also create, maintain and distribute extensions to meet the needs of particular software solutions and customers.
4. See also Edition which refers to the combination of an extension with the International Release and, where relevant, any modules from other extensions on which it depends.

Alternatives
Extension

SNOMED CT Identifier
A unique integer identifier applied to each SNOMED CT component (Concept, Description, Relationship, Subset, etc.). Each SCTID includes an item identifier, a check-digit, a partition identifier and, depending on the partition identifier, may also include a namespace identifier.

Alternatives
Identifier
SCTID

SNOMED CT International Edition
The part of SNOMED CT that is maintained and distributed by the IHTSDO and available to all IHTSDO Members and Affiliates as the shared foundation of the terminology.

Notes:
1. The International edition, provided by the IHTSDO, may be supplemented by Extensions maintained by IHTSDO Members and Affiliates to meet additional national, local and organisational requirements.
3. The International release refers to a release of content from the International edition at a particular release date.

Alternatives
International edition

SNOMED CT International Release
The set of release files provided on a specified release date, to represent the part of the content of SNOMED CT that forms the common foundation to the terminology available to all IHTSDO Members and Affiliates.

Notes:
1. The International release, provided by the IHTSDO, may be supplemented by Extension releases provided by IHTSDO Members and Affiliates to meet additional national, local and organisational requirements.
2. See also International Edition which refers to the same general content, without specifying a particular release date.

Alternatives
International Release

SNOMED CT Module
A group of SNOMED CT components and/or reference set members that are at a given point in time managed, maintained and distributed as a unit.

Notes:
1. Components and reference set members that are part of the same module are share the same moduleId value.
2. Each component and reference set member is a part of one and only one module as at a given point in time.
3. The organisation responsible for a module can move a component and reference set member from that module to another module that the same organization is responsible for, by creating a revised version.
of the component or reference set member with a different moduleId that applies from the effectiveTime of the revised version.

4. Subject to rules related to movement of components between two extensions or between an extension and the International Edition, it is possible for a component and reference set member to be moved between modules maintained by different organisations.

Alternatives
Module

SNOMED CT National Edition
The combination of a National Extension with the SNOMED CT International Edition and, where relevant, any module from other Extensions on which the National Extension depends.

Note: The National Edition may be made available to licensees at a particular release date as part of a National Release. However a National Edition can also be derived by combining the National Extension release files with relevant release data from the SNOMED CT International Edition and any other Extensions on which it depends.

Alternatives
National Edition

SNOMED CT National Extension
A SNOMED CT Extension that is maintained by an IHTSDO Member for use in a particular country.

Note: See also National Edition which refers to the combination of a National Extension with the International Release and, where relevant, any modules from other Extensions on which it depends.

Alternatives
National Edition

SNOMED CT National Release
A National Extension and/or National Edition as made available to licensees by an IHTSDO Member at a particular release date.

Notes:

1. The National Release is made available as a set of release files which contain components and derivatives from a National Extension maintained and distributed by an IHTSDO Member.
2. A National release may also include the SNOMED CT International Release on which it depends, in which case it is a release of the National Edition.
3. Alternatively, a National Release may consist only of the National Extension release files for the specified release date. In this case, the National Edition is generated by combining these files with the International Release on which it depends.

Alternatives
National Release

SNOMED International
SNOMED International is the version of SNOMED® that was first released in 1993 and which, as version 3.5 released in 1998, It was the immediate predecessor of SNOMED RT.

SNOMED Reference terminology
The version of SNOMED® prior to the collaborative effort to develop SNOMED Clinical Terms. It was one of the source terminologies, along with CTV3, from which SNOMED CT was developed.

Alternatives
SNOMED RT

Sponsored Territory
A Non-Member Territory that has been recognised and designated by the Licensor (IHTSDO) as a sponsored territory

**Note:** SNOMED CT may be used free of charge by IHTSDO affiliates and their sub-licensees in Sponsored Territories. Information about Sponsored Territories is published on the IHTSDO web site.

### Stated view

The *stated view* of a Concept definition consists of the Relationships directly edited by terminology authors. It consists of the stated subtype Relationships plus the defining Relationships that exist prior to running a Description Logic classifier.

**Note:** The Relationships distributed in the main Relationships files are inferred from the stated Relationships using a Description Logic classifier to ensure consistency and completeness. The *stated view* is distributed in the Stated Relationships File.

### Alternatives

**Stated form**

### Statistical classification

A hierarchical organisation of *terms* or ideas that allows aggregation into categories that can be counted and compared without double counting. A *statistical classification* is monohierarchical which means that each node in the hierarchy is part of one node at the level above. This avoids double counting but means that arbitrary decisions must be made where a node is naturally related to more than one parent. For example, in a statistical classification such as ICD-10, 'bacterial pneumonia' is be related to 'lung disorder' or 'infection disorder' but not to both.

### Structure-Entire-Part

A modeling approach used in SNOMED CT to represent anatomical entities such as body organs, body systems, body regions, etc.

- **Structure** is the most general way to refer to an organ, body system or region.
- **Entire** refers to a complete organ, body system or region.
- **Part** refers to a part of an organ, body system or region. It explicitly does not refer to the entire organ, body system or region.

**Example:** The figure below illustrates the relationships between the structure, entire and part concepts applied to the heart.

- 80891009| heart structure |
- 302509004| entire heart |
- 119202000| heart part |

![Heart Structure diagram](image)

**Figure 141: Structure-Entire-Part applied the heart**

### Alternatives

**SEP**

### Subset

A set of *components* which part of and fully included with a larger set (e.g. a specified set of Concepts or Descriptions)
Notes:

1. In Release Format 2 the standard way to represent a subset of components is by using a Simple Reference Set.

2. In Release Format 1 the term subset has the following special meaning:

   - A group of components (e.g. Concepts, Descriptions or Relationships) that share a specified common characteristic or common type of characteristic. Subsets represent information that affects the way the components are displayed or otherwise accessible within a particular realm, specialty, application or context.

This special meaning arose from the "Subset Mechanism" which has now been replaced by Reference Sets. Therefore, except when referring to RF1 files the term subset should be used for its more correct general meaning.

Subsumption test

A test to determine whether a specified candidate concept or expression is a subtype descendant of another specified concept or expression.

Alternatives

- Subtype test

Subtype

A specialisation of a concept, sharing all the definitional attributes of the parent concept, with additional defining characteristics. For example, bacterial infectious disease is a subtype of infectious disease. Bacterial septicemia, bacteremia, bacterial peritonitis, etc. are subtypes of bacterial infectious disease (and infectious disease as well). Subtype is sometimes used to refer to the concepts in a hierarchy that are directly related to a parent concept via the | is a | relationship. In this usage, it is distinguished from descendants which explicitly includes subtypes of subtypes.

Subtype child

A concept that has a direct | is a | subtype Relationship to a specified concept. See also subtype and subtype descendant.

Example:

The figure below shows an example hierarchy in which concept "E" has three subtype children (G, H and J).

![Hierarchy Illustration - Subtype children](image)

Subtype classification

A classification hierarchy in which each node is connected to its supertypes. This allows aggregation of information based on a hierarchy of types.

Alternatives

- Subtype hierarchy
**Subtype descendant**

All subtypes of a concept, including subtypes of subtypes. For example, if a concept has four children, then descendants are those children plus all the concepts that are descended from those four children. See also subtype and subtype child.

**Example:**

The figure below shows an example hierarchy in which concept "E" has eight subtype descendants (G, H, J, L, M, N, S and T).

![Hierarchy Illustration - Subtype descendants](image)

**Alternatives**

**Descendant**

**Sufficiently defined concept**

A concept with a formal logic definition that is sufficient to distinguish its meaning from other similar concepts.

**Note:**

The meaning of SNOMED CT concept is expressed in a human-readable form by its Fully Specified Name (FSN) and has a formal logic definition represented by a set of defining relationships to other concepts. A Sufficiently defined concept has sufficient defining relationships to computably distinguish it from other concepts.

See also primitive concept.

**Example:** The concept 74400008|appendicitis (disorder)| is sufficiently defined by the following definition because any concept for which this definition was true would be the disorder "appendicitis".

- 116680003 | is a | = 18526009 | disorder of appendix |
- 116680003 | is a | = 302168000 | inflammation of large intestine |
- 116676008 | associated morphology | = 23583003 | inflammation |
- 363698007 | finding site | = 66754008 | appendix structure |

**Alternatives**

**Fully defined concept**

**Supertype ancestor**

Any concepts of which the specified concept is a subtype. Includes the supertype parents and the supertype parents of each supertype parent and so on recursively until the root concept is reached.

**Example:**

The figure below shows an example hierarchy in which concept "T" has ten supertype ancestors A, B, C, D, E, F, G, H, J, and M.
Figure 145: Hierarchy Illustration - Subtype ancestors

**Alternatives**

**Ancestor**

**Supertype parent**

A concept that is the target of a direct or a subtype Relationship from a specified concept (see also supertype ancestor).

**Example:**

The figure below shows an example hierarchy in which concept "T" has two supertype parents (J and M).

Figure 146: Hierarchy Illustration - Supertype parents

**Synonym**

A term that is an acceptable way to express the meaning of a SNOMED CT concept in a particular language.

**Note:**

1. Synonyms are represented as SNOMED CT descriptions with the typeId value 900000000000013009 | Synonym |.
2. Synonyms allow representations of the various ways a concept may be described.
3. Synonyms (unlike fully specified names) are not necessarily unique because the same term can be used to describe more than one concept.
4. The preferred term is the synonym marked as preferred for use in the Language reference set for a given language or dialect.

**T**

**Target code**

A code or other Identifier within a Target Scheme.

**Target scheme**

A terminology, coding scheme or classification to which some or all SNOMED CT Concepts are mapped.

**Technology Preview**
An experimental status applied to a collection of SNOMED CT release files that represent a proposed additions of components and/or derivatives to the SNOMED CT International Release or to a SNOMED CT Extension. The Technology Preview status indicates the releasing party (IHTSDO or the owner of the Extension) is only releasing these additional components or derivatives for review and testing by implementers and other stakeholder. The objective of a Technology Preview is to test the chosen approach and elicit comments before committing to the content and/or release format for the additional material. It is likely that, prior to release of a Candidate Baseline, significant changes may be made to address comments made and issues identified by testing.

Note: The significance a Technology Preview release is that this data should not be used in an operational environment that may incorporate the data into a record or create a dependency on continued maintenance of the additional components or derivatives.

**Term**
A human-readable phrase that names or describes a concept. A term is one of the properties of a description. Other properties of a description link the term to an identified concept and indicate the type of description (e.g. Fully Specified Name, Synonym, etc.).

**Terminology binding**
A link between a terminology component and an information model artefact, such as class or attribute in a electronic health record or message.

Notes:
1. Terminology components include SNOMED CT expressions, reference sets and constraints.
2. Information model artefacts include classes and attributes in reference models for electronic health records and communication specifications.
3. Terminology binding can also be used to refer to the process of creating and persisting links between terminology components and information model artefacts.

Examples:
1. A set of coded values that may be applied to a particular attribute in an information model. The set may be expressed either explicitly (extensionally) or as a definitional constraint (intensionally).
2. The association between a named attribute value in the information model and a specific coded value or expression.
3. A rule that determines the way that a coded expression is constructed based on multiple attribute values in the information model.

**Terminology server**
Software that provides access to SNOMED CT (and/or to other terminologies). A terminology server typically supports searches and Navigation through Concepts. A server may provide a user interface (e.g. a browser or set of screen controls) or may provide low-level software services to support access to the terminology by other applications. See the SNOMED CT Technical Implementation Guide.

Alternatives
- SNOMED CT terminology server

**Terminology services**
Functions performed by software that interacts with one or more representations of the terminology and provide access to information derived from the terminology.

Note: Terminology services can be generalised, so that they are independent of the way the terminology is used in a particular application. Terminology services may be used by record services that enter, store and retrieve information that includes SNOMED CT expressions. In contrast to terminology services, record services are usually specific to the design of a particular application.

Textual definition
An additional textual description applied to some SNOMED CT concepts that provides additional information about the intended meaning or usage of the concept.

**Note:**

Textual definitions are distributed in a file that follows the same structure as the Description file (RF2) but the terms permitted by the "textual definition" are much longer the 255 character limited applied to synonyms and fully specified names. Textual definitions are not essential for SNOMED CT implementations but they are useful as they provide narrative Descriptions of concepts that may be easier to understand than the shorter terms.

These Descriptions go beyond the detail of the Fully Specified Name as shown in the example below.

**Example:**

Table 314: Textual Definition

<table>
<thead>
<tr>
<th>conceptId</th>
<th>Fully Specified Name</th>
<th>Textual Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>11530004</td>
<td>Brittle diabetes mellitus (finding)</td>
<td>Diabetes mellitus in which there are frequent, clinically significant fluctuations in blood glucose levels both above and below levels expected to be achieved by available therapies.</td>
</tr>
</tbody>
</table>

**Top level concept code**

A Concept Code that is directly related to the Root Concept Code by a single Relationship of the Relationship Type | is a |. All Concept Codes (except for metadata concepts) are descended from at least one Top-Level Concept Code via at least one series of Relationships of the Relationship Type” | Is a | “.

**Top level metadata code**

A Concept Code that is directly related to the Root Metadata Code by a single Relationship of the Relationship Type | is a |. All Metadata Concept Codes are descended from at least one Top-Level Metadata Concept Code via at least one series of Relationships of the Relationship Type” | Is a | “.

**Note:** Most of the data in the metadata hierarchy is only relevant to Release Format 2. Therefore, this concept may not be present in Release Format 1 files.

**Transitive closure**

A comprehensive view of all the supertype ancestors of a concept derived by traversing all the | is a | relationships between that concept and the root concept.

**Note:** A transitive closure table represents the transitive closure of all active concepts.

**Translation**

The process of rendering text originally written in one language (source language) into another language (target language).

**Translation source language**

The language in which the original text is written.

**Example:** English is the source language for the International edition of SNOMED CT.
Translation target language
A language into which the original text is being translated or rendered.

**Example:** For the Spanish language edition, Spanish is the target language.

**Alternatives**
- Target language

Translation Service Provider
Person or organisation supplying a translation service.

**Alternatives**
- TSP

**U**

Understandability, Reproducibility and Usefulness
Criteria applied to test the validity of new concepts and design features of SNOMED CT.

- Understandable: The meaning of a concept can be understood by an average health care provider, without reference to private or inaccessible information.
- Reproducible: Multiple users apply the concept to the same situations.
- Useful: The concept has a practical value to users that is self-evident or can be readily explained.

**Alternatives**
- URU

Union
In set theory union of the sets A and B, is the set of all objects that are a member of A, or B, or both.

**Note:** Set theory is applied when describing the intended result of combinations of Reference Sets or Constraints.

User interface
The way a software application presents itself to a user including, its on screen appearance, the commands it puts at a users disposal, and the manner in which the user can access and update information by using the application.

**Alternatives**
- UI

**V**

Value Set
A uniquely identifiable set of valid concept representations, where any concept representation can be tested to determine whether or not it is a member of the value set.

**Notes:**
1. This definition is used in HL7 Vocabulary Working Group documents. In SNOMED CT a concept representation may be a concept identifier or a SNOMED CT Expression.
2. A Reference set can be used to represent a value set of SNOMED CT concepts each of which is represented by a concept identifier in the referencedComponentId field.

Word equivalent
A word or abbreviation that is stated to be equivalent to one or more other words, phrases or abbreviations for the purposes of textual searches of SNOMED CT. Word Equivalents and Phrase equivalents are represented as rows in the Word Equivalents Table.

Workbench
A set of IHTSDO sponsored software tools designed to support the development, maintenance, and use of SNOMED CT in health systems around the world.

Alternatives
IHTSDO Workbench

World Health Organization
the directing and coordinating authority for health within the United Nations system. The World Health Organization (WHO) maintains the International Statistical Classification of Diseases and Related Health Problems (ICD).

Alternatives
WHO