3 Introduction to SNOMED CT

This section provides a brief description of the key characteristics of SNOMED CT, how to access SNOMED CT, some of the other services offered by SNOMED International, and how SNOMED CT can be used with other terminology and related health informatics standards. For a detailed introduction to SNOMED CT, the reader should refer to the SNOMED CT Starter Guide available from http://snomed.org/sg.

Key Characteristics

SNOMED CT:

- Is the most comprehensive, multilingual clinical healthcare terminology in the world
- Includes diagnoses, signs, symptoms, procedures, body structures, organisms and substances
- Is a resource with comprehensive, scientifically validated clinical content
- Ensures quality clinical content in electronic health records
- Is mapped to other international standards

SNOMED CT components include:

- Concepts representing clinical thoughts and phrases that are organized into hierarchies
- Descriptions which link appropriate human readable terms to concepts
- Relationships which link each concept to other related concepts

When implemented in software applications, SNOMED CT can represent clinically relevant information consistently, reliably and comprehensively as an integral part of producing and using electronic health information.

SNOMED CT Components

SNOMED CT is a core clinical healthcare terminology that contains concepts with unique meanings and formal logic based definitions organized into hierarchies.

Concepts

SNOMED CT concepts represent clinical thoughts, ranging from abscess to zygote. Every concept has a unique numeric concept identifier using up to 18 digits. Within each hierarchy, concepts are organized from the general to the more detailed. This allows detailed clinical data to be recorded and later accessed or aggregated at a more general level.

Descriptions

SNOMED CT descriptions link appropriate human readable terms to concepts. There are several different types of Description of which the two most important are "fully-specified name" (FSN) and "synonym". The FSN is an unambiguous formally structured phrase that specifies the meaning of the concept. Synonyms are other terms that are used to refer to the same meaning. Each translation of SNOMED CT includes an additional set of descriptions, which link terms in another language to the same SNOMED CT concepts.

Figure 2 shows a concept with the identifier (128601007), a fully specified name and three English language synonyms.
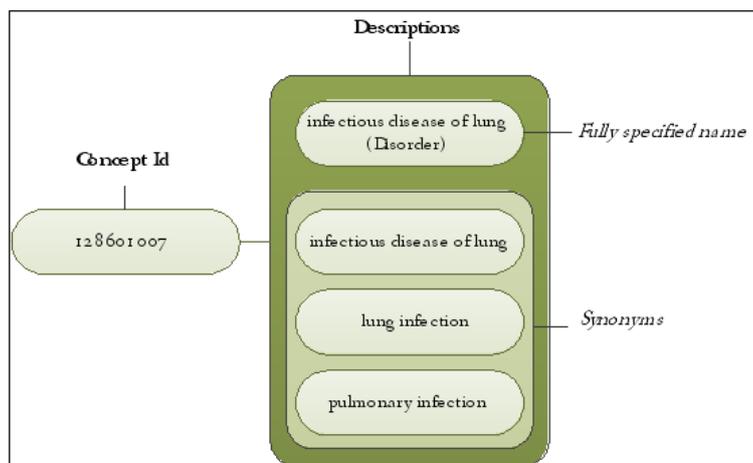

Figure 2.SNOMED CT synonyms enable users to choose which terms they want to represent a concept

Relationships

SNOMED CT relationships link each concept to other concepts that have a related meaning. These relationships provide formal definitions and other characteristics of the concept. A common type of link is the hierarchical relationship which relates a concept to more general concepts. For example, the concept *viral pneumonia* is a child of the more general concept *pneumonia*. Such relationships which define the hierarchy of SNOMED CT concepts are represented as |is a| relationships.

Other types of relationships represent other aspects of the definition of a concept. For example, the concept *viral pneumonia* has a *causative agent* relationship to the concept *virus* and a *finding site* relationship to the concept *lung*.

Comprehensive, Scalable and Flexible

SNOMED CT has a broad coverage of health related topics. It can be used to describe a patient's medical history, the details of an orthopedic procedure, the spread of epidemics, and much more. At the same time, the terminology has an unmatched depth, which enables clinicians to record data at the appropriate level of granularity.

Specific applications tend to focus on a restricted set of SNOMED CT, such as concepts related to ophthalmology. These subsets can be used to present relevant parts of the terminology, depending on the clinical context and local requirements.

When individual jurisdictions have needs beyond those that can be reflected in a global terminology, perhaps due to requirements in local legislation, they can develop local or national extensions. Thus, even though SNOMED CT is global in scope, it can be adapted to each country's or area's requirements. Vendors can also create extensions for concepts specific to their own systems, or for subsets to support implementation.

SNOMED CT maps work to provide explicit links to health related classifications and coding schemes in use around the world. These maps facilitate reuse of SNOMED CT based clinical data for other purposes, such as reimbursement or statistical reporting.

Maps included in the SNOMED CT International Edition include:

* SNOMED CT to ICD-10 (to be released in July 2015)
* SNOMED CT to ICD-9-CM
* ICD-O (linking SNOMED CT morphologies with ICD-O codes)
* SNOMED CT GP/FP subset to ICPC-2 (WONCA

  , a classification for use in primary care / family practice)

Further SNOMED International maps are under development or in field trials such as

* Preview release of an initial set of links between LOINC Part Codes and SNOMED CT and associations between LOINC Terms and SNOMED CT expressions

An up-to-date list of maps is at http://snomed.org/mapinfo.

Supporting Different Languages

SNOMED CT is a multinational, multilingual terminology. It has a built-in framework to manage different languages and dialects. The International Release includes a set of language independent concepts and relationships. Today, SNOMED CT is available in US English, UK English, Spanish, Danish and Swedish. Partial translations into French, Lithuanian, Portuguese, Dutch and several other languages are currently taking place. Members are also planning to translate the standard into other languages. An up-to-date list of translations of SNOMED CT is at http://snomed.org/translationinfo.

SNOMED CT Expressions

A single concept identifier can be used to represent any of the 400,000+ concepts in SNOMED CT e.g. pneumonia. In some cases, even finer granularity of meaning may be required to capture the true intent of a clinician's statement e.g. pneumonia caused by streptobacillus. In these cases, SNOMED CT provides a formal mechanism of using two or more concept identifiers linked together in a logical way to represent refinements of the meaning of a concept. These are known as postcoordinated expressions. For example 'pneumonia caused by streptobacillus' can be expressed by:

409664000| bacterial pneumonia |**:246075003**| causative agent |**=29295005**| Streptobacillus |

It is not essential for vendors to implement postcoordination unless there are requirements for representing meanings that cannot be captured using a single concept identifier. Even in cases where more specific information is needed, there are other options that can be used. These include using specific fields in the user interface or message to capture specific refinement patterns such as laterality. However, postcoordinated expressions provide a flexible way to represent additional detail, where this is required.

* Expressions which identify a concept using only a single concept identifier are referred to as 'precoordinated'
* Expressions which rely on the composition of multiple concept identifiers, as illustrated above, are referred to as 'postcoordinated'.

Logical Representation of Meaning

In addition to the human-readable representation of meaning (provided by descriptions), SNOMED CT includes relationships between concepts which provide a machine-processable representation of the meaning of each concept. These defining relationships provide the foundation for meaning-based retrieval.

Each SNOMED CT Concept (except the root concept) has a relationship to one or more parent concepts. Each of these parent concepts represents a more general clinical meaning (known as a supertype). The resultant network of relationships is more than a simple tree and forms a logical structure known as a polyhierarchy

2 . This structure makes it possible to represent meaning in a more complete way than is possible in a simple hierarchy.

For example, a simple hierarchy could only represent |cellulitis of foot| as either a type of |disorder of foot| or a type of |cellulitis|. As shown in in Figure 3, the SNOMED CT subtype polyhierarchy captures both of these supertype relationships.
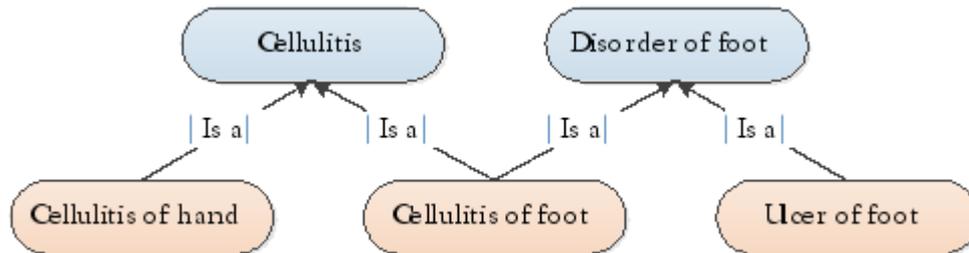

Figure 3. Fragment of the SNOMED CT subtype polyhierarchy showing a concept with two supertype parents

In addition to the relationships that form the subtype polyhierarchy, SNOMED CT also includes other relationships which represent features of a concept that distinguish it from its supertypes. For example, as shown in Figure 4, the defining relationships of |cellulitis of foot| also include relevant values for |associated morphology| and |finding site|.
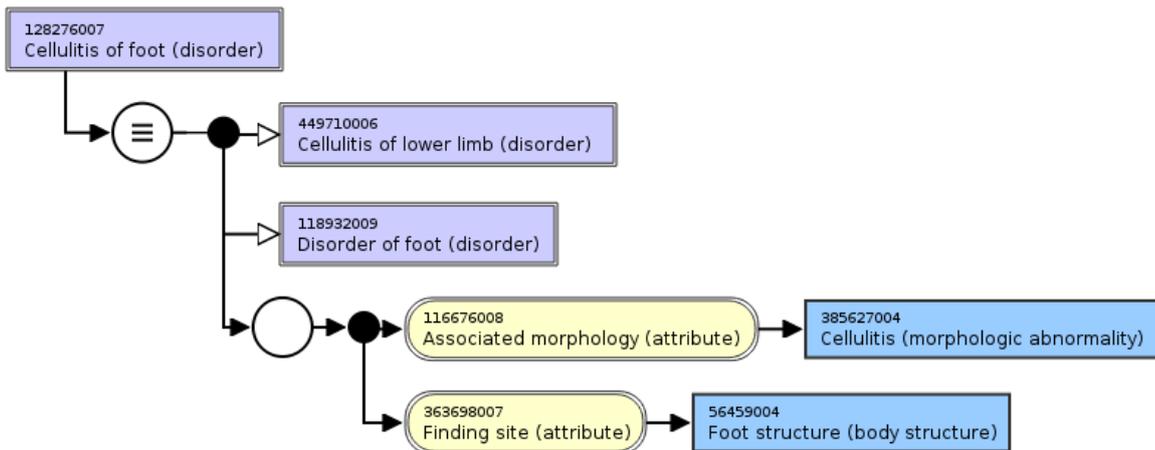

Figure 4. Defining relationships of cellulitis of foot

Concepts, their descriptions and relationships can be explored using the SNOMED International Browser (http://browser.ihtsdotools.org).

Standard Release Format with Built in Versioning

SNOMED CT has standardized methods for packaging and distribution of content and derivatives. Files in the distribution follow a formal naming convention and have a standardized tab-delimited release format that includes full version tracking for every version of each component since the launch of SNOMED CT in 2002. The release files include files for Concepts, Descriptions, Relationships and an extensible Reference set file structure used to represent maps, subsets and language preferences.

The versioning mechanism supports the distribution of three distinct representations of the release data. The FULL release type is the master copy that contains all versions of every component released. The SNAPSHOT release type contains only the most recent version of every component, and provides a simple way to implement a service that does not require access to earlier versions. The DELTA release type is a smaller release package that contains only the additional and revised components since the last release. The previous FULL release can be updated to the latest FULL release simply by appending the content of the latest DELTA release.

Continuous Improvement

SNOMED CT is the subject of continuous improvement such as the addition of new concepts where needed or refinement of concept definitions. The quality assured content is released in discrete releases. SNOMED CT has robust version control of all components based on an 'effective date' mechanism. The data includes a full and explicit history of all versions of all components whether or not they are currently active.

Accessing SNOMED CT

Reviewing SNOMED CT Content

SNOMED International provides a Terminology Browser to enable online review of the SNOMED CT International Edition (http://browser.ihtsdotools.org). This browser also provides access to several National Editions of SNOMED CT. Other SNOMED CT browsers are listed at http://snomed.org/browsers.

Obtaining SNOMED CT Release Files

Licensing and Access to Release Files

All vendors, developers and providers of SNOMED CT enabled products and services are required to register acceptance of the SNOMED CT Affiliate License Agreement. By doing this they become SNOMED International Affiliates and gain access to downloads of the SNOMED CT International Edition and derivatives. Some Member countries require use of their National Edition of SNOMED CT and access to this may be subject to an additional license agreement. More information on licensing, including end-user sublicensing and fees for use in Non-Member Territories, is provided in Section 7.

Downloading the International Edition

National Release Centers in several Member countries host their own distribution sites that allow SNOMED International Affiliates that are registered with them to download the International Edition of SNOMED CT. SNOMED International provides a central service for SNOMED International Affiliates to download the International Edition

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Downloading National Extensions or Editions

National Release Centers (NRCs) in Member countries that maintain National Extensions provide these Extensions to SNOMED International Affiliates registered with them. In some cases, the National Extension and International Edition may be distributed in a pre-merged form representing the complete National Edition. For details see the links to SNOMED International Members from http://snomed.org/members.

Release Dates

The International Edition is released every six months on January 31st and July 31st. National Extensions are often released two or three months after the relevant international release.

Other SNOMED International Services

Documentation

The SNOMED CT Document Library at http://snomed.org/doc provides access to detailed specifications of SNOMED CT design and release file formats. The library also provides access to related standards and guidelines as well as some more informal papers and draft materials. These documents are available as online web browsable pages and/or as downloadable PDF files. In most cases, updated versions of the documents are released every six months to coincide with the International release dates at end of January and July.

Education

The SNOMED CT E-Learning Server at http://elearning.ihtsdotools.org provides access to a growing range of online tutorials and education resources. Since 2015, SNOMED International has launched a SNOMED CT Foundation E-Learning Course which runs at regular intervals. Announcements for future course intakes are published on the SNOMED International website (www.snomed.org/). Future e-learning courses are planned on Implementation and SNOMED CT Content Editing

Some National Release Centers also provide a range of materials and services in support of implementation and several host local implementation communities. For more information, please refer to the relevant Member by following links http://snomed.org/members.

Tools and Services

SNOMED International is developing a range of tools mostly targeted at supporting terminology development and distribution centrally by SNOMED International and nationally by NRCs in Member countries. These tools are developed following open source principles and therefore may be of practical or illustrative value to vendors. See details at http://snomed.org/tools.

There are also other providers of tools and services that support implementation of SNOMED CT. These include commercial providers as well as some development by SNOMED International Members following an open source model.

Requests for Changes and Additions

SNOMED International provides a request submission service to gather and process requests for additions and changes to the content of the SNOMED CT International Edition. This service is directly accessible by National Release Centers (NRC) in Member countries and recognized Terminology Authorities representing standards organizations with whom SNOMED International is collaborating.

Vendors in Member countries should submit their requests initially to the NRC in the country in which they are based or the country in which the requirement for the addition or change has been noted. Requests with particular local relevance may be added to a National Extension, but those that the NRC considers have international relevance will be forwarded to SNOMED International for a decision. If a request is deemed to have high priority, it should result in action in the next release cycle. However, requests that require significant changes that would impact on other content may take longer.

Using SNOMED CT with Other Standards

SNOMED CT is only one part of the solution to the challenges of making effective use of clinical information. Therefore, SNOMED International cooperates with many organizations to optimize practical benefits and minimize duplication of effort. This section outlines some key areas where this collaborative approach is driving developments that address the needs of healthcare provides, EHR vendors and users and other stakeholders with an interest in consistent representation of health related information.

World Health Organization Classifications

SNOMED International has a formal working arrangement with the World Health Organization (WHO) to develop and assure maps and links between SNOMED CT and WHO Classifications. SNOMED CT to ICD-9-CM and SNOMED CT to ICD-10 maps are distributed by SNOMED International.

SNOMED International has also taken part in cooperative work to develop maps between SNOMED CT and other international classifications including ICD-O (International Classification of Diseases for Oncology and ICPC-2 (International Classification of Primary Care).

LOINC (Logical Observation Identifiers Names and Codes)

In July 2013 SNOMED International signed a long-term agreement with the Regenstrief Institute Inc. (RII) owners of LOINC (Logical Observation Identifiers Names and Codes). This agreement marked the beginning of cooperative work which will link LOINC and SNOMED CT. These links will help improve safety, functionality and interoperability for the growing number of healthcare professions who use and exchange electronic health records that use both SNOMED CT and LOINC.

The cooperative work builds on and complements the strengths of both organizations and terminologies. It will link the rich clinical semantics of SNOMED CT to LOINC Parts and Terms, which provide extensive coverage of laboratory tests and some types of clinical measurements. One result of this will be alignment of the attributes of laboratory tests. This will enable LOINC and SNOMED CT to be used together in a consistent and interoperable manner. SNOMED International have also been working with RII to develop a guidance document on Using SNOMED CT and LOINC together. This guide will be published in 2015.

HL7 Message Standards, CDA and FHIR

SNOMED International has a long-standing collaboration agreement with HL7. The focus of this agreement is enabling effective use of SNOMED CT in HL7 messages. SNOMED International supported the work of the HL7 Vocabulary Committee developing the HL7 TermInfo implementation guide on 'Using SNOMED CT in CDA R2 Models'. Following a positive ballot, final revisions are being made to address and resolve ballot comments prior to publication in 2015.

Other areas of cooperation include the use of SNOMED CT codes in the value sets used in HL7 message specifications. This includes agreeing a common way for HL7 Committees to request additions or changes to SNOMED CT to support message development. It also includes work to develop a consistent approach to representing bindings between SNOMED CT codes and expressions and HL7 models and message specifications.

SNOMED International is also working with HL7 to ensure that SNOMED CT can be used effectively in specifications based on FHIR (Fast Healthcare Interoperable Resources) hl7.org/fhir.

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[1] WONCA: World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians

[2] More precisely the |is-a| relationship polyhierarchy is a Directed Acyclic Graph [DAG]

[3] The current SNOMED International licensing and download service (https://mlds.ihtsdotools.org) is targeted at Affiliates in Non-Member Territories and those in Member countries that do not currently provide a download site.