FACULTY OF MEDICINE AND HEALTH SCIENCES

# SNOMED CT

SNOClass brochure

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# 1 INTRODUCTION TO SNOMED CT

## 1.1 Summary

SNOMED CT (Systematized Nomenclature of Medicine – Clinical Terms) is a comprehensive, standardized clinical terminology used in health care to ensure consistent and accurate representation of medical concepts and clinical content in EHR. It provides a structured framework for coding, sharing, and analysing health information, including diseases, symptoms, procedures, and medications. By facilitating clear communication among health care providers and improving the interoperability of electronic health records (EHRs), SNOMED CT enhances patient care, safety, and health data management. It is used in more than 80 countries, available in multiple languages and dialects and the International Edition is released monthly, containing more than 370 000 clinical concepts. It is currently mapped to other international standards such as ICD-9-CM, ICD-10, ICD-O-3, ICD-10-AM, Laboratory LOINC and OPCS-4 + ICPC-2.
SNOMED CT is operated by SNOMED International which provides an online browser to navigate the resource: https://browser.ihtsdotools.org/

## 1.2 History

The project started in 1965 as SNOP [Systematized Nomenclature of Pathology], which was developed into a logic-based health care terminology. In 1999, in expanded with the merger, expansion and restructuring of SNOMED RT [Reference Terminology, College of American Pathologists (US)] and CTV3 [Clinical Terms Version 3, National Health Service (UK), General Practice] that gave 2002 SNOMED CT. In 2003, SNOMED CT was made available at no cost for US through NLM UMLS [National Library of Medicine, Unified Medical Language System]. In 2007, CAP [College of American Pathologists] transferred the intellectual property to IHTSDO [International Health Terminology Standards Development Organisation].

## 1.3 Belgium

Acting as the SNOMED National Release Centre (NRC) of Belgium, the Terminology Centre of the Federal Public Service Health, Food Chain Safety and Environment is responsible for distributing and managing SNOMED CT in Belgium. It also produces translations of the terminology in Dutch and French. The first Belgian SNOMED CT release dates back from March 2018. In the meantime, the content of the Belgian language refset has increased to nearly 580.000 Dutch and 250.000 French validated translations. In terms of coverage, the current Belgian extension contains validated Dutch descriptions for almost 280.000 concepts and validated French descriptions for almost 170.000 concepts. Every six months, a new release is published and made available.
See: www.health.belgium.be and https://www.snomed.org/members/belgium

## 1.4 Features

SNOMED CT is the most comprehensive, multilingual clinical healthcare terminology. It provides a standardized vocabulary, scientifically validated, to support health care professionals to communicate with reduced ambiguity. By using a consistent terminology, it helps minimize errors in patient care by reducing the risk of misinterpretation. This leads to better clinical decision-making and ultimately enhances patient safety. It improves interoperability and facilitates the exchange of health information

across various electronic health record (EHR) systems. It also allows for the systematic collection and analysis of health data that health care organizations can then aggregate for research, quality improvement, and public health monitoring, or clinical decision support systems.

# 2 SNOMED CT DESIGN

It is a terminology of concepts with unique meanings and formal logic-based definitions organized into multiple hierarchies. The content is represented using three components:

- **Concepts** representing clinical meaning: they are the foundational building blocks of SNOMED CT. Each concept represents a unique clinical idea, such as a disease, symptom, procedure, or medication. Concepts are identified by a unique numeric identifier.
    - For instance, « Diabetes mellitus (disorder) » concept as a unique SNOMED CT ID: 73211009
- **Descriptions** which link appropriate human readable terms to concepts. Each concept can have multiple descriptions, including Fully Specified Names [FSN] and synonyms (alternative names). This flexibility allows health care providers to use terminology that is familiar to them while ensuring that the underlying concept remains consistent.
    - For instance, "Cholecystostomy " and "Removal of gallbladder (procedure)" may both be used to refer to the same concept, enhancing usability for clinicians.
- **Relationships** which link each concept to other related concepts within the SNOMED CT framework. These relationships illustrate the associations between different concepts, such as hierarchical relationships (e.g., a specific condition being a subtype of a broader category) and associative relationships (e.g., a symptom being related to a particular disease).
    - For instance, « Cholecystostomy » has for attributes « Procedure site - Direct → Gallbladder structure » and « Method → Incision - action ». An important characteristic of attributes is that they can be constrained regarding their domain and range. The attribute « Causative agent » can have for domain « disorder » but not « body structure » and for range « organism » but not « morphological abnormality ». This relational structure enables complex queries, for instance with the ECL [Expression Constraint Language] and supports clinical decision-making by allowing providers to understand the context and implications of various clinical terms.

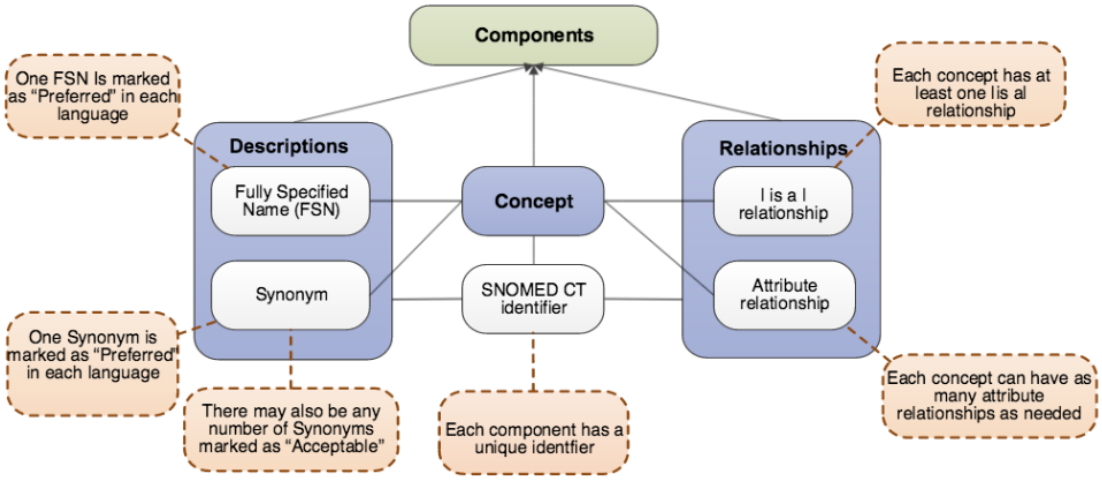


*Figure 1: From « SNOMED CT Starter Guide » - http://snomed.org/sg*

An additional fundamental component are the **Reference sets (Refsets)**, a flexible standard approach to support a variety of requirements for customization and enhancement of SNOMED CT. These include the representation of subsets, language preferences for use of some terms and mapping from or to other code systems. Every reference set has a unique numeric concept identifier. National editions of SNOMED CT create reference sets that fit their needs, for instance translations, or mapping to local terminologies.

# 3 HIERARCHIES (DOMAINS) AND SEMANTIC TAGS

SNOMED CT consists in 19 concepts hierarchies starting from a common ancestor « SNOMED CT Concept (SNOMED RT+CTV3). They aim at covering the entirety of health-related domains.

| | |
|---|---|
| Body structure | Qualifier value |
| Clinical finding | Record artifact |
| Environment or geographical location | Situation with explicit context |
| Event | SNOMED CT Model component |
| Observable entity | Social context |
| Organism | Special concept |
| Pharmaceutical/biologic product | Specimen |
| Physical force | Staging and scales |
| Physical object | Substance |
| Procedure | |

These hierarchies are the backbone of SNOMED CT. The concepts go from the more general to the more specific, with an |is a| relationship. For instance, « Body Structure » |is a| SNOMED CT Concept (SNOMED RT+CTV3) ».
Some concepts have multiple ancestors. « Cholecystostomy » |is a| « Biliary tract incision » and also « Cholecystostomy » |is a| « Operation on gallbladder ».
Each SNOMED CT concept FSN ends with a Semantic Tag between brackets, like “(procedure)”. Semantic Tags are not defined, have an inner hierarchy, and are useful to alleviate ambiguity between concepts with identical lexical representations.

## 3.1 Detailed example

### 3.1.1 Diagram

Using the SNOMED CT Browser allows to navigate the resource and display the information contained in various forms, including a diagram.

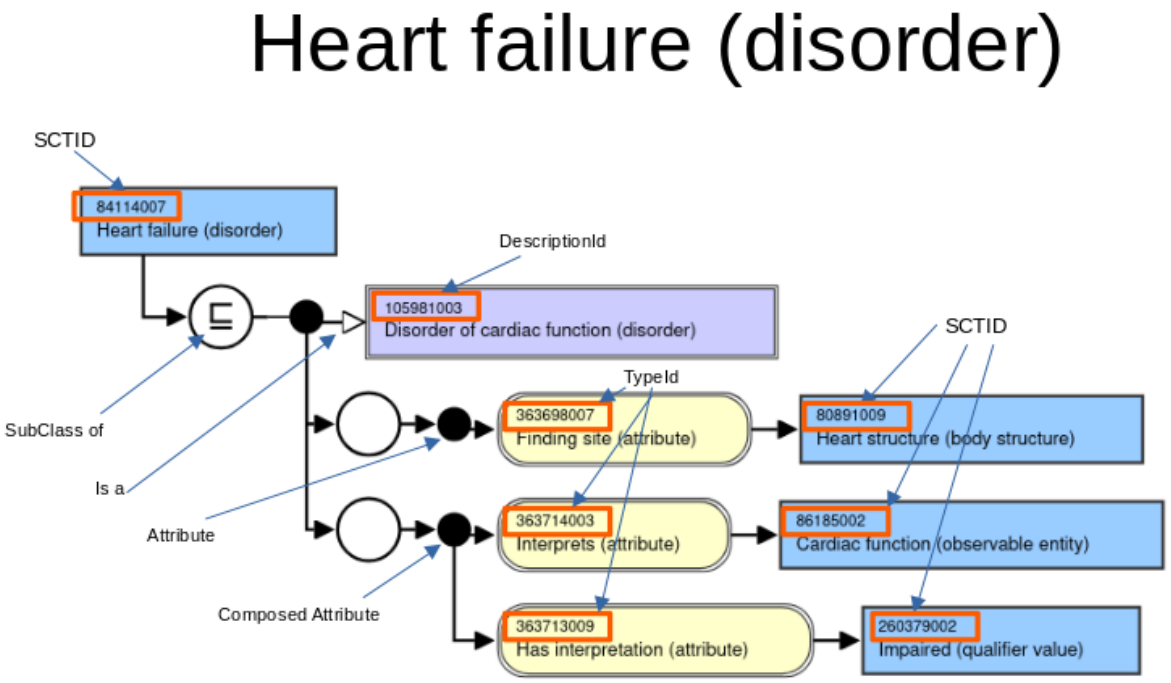


*Figure 2: Diagram view of Heart failure (disorder) concept from SNOMED CT Browser*

The diagram view shows the unique identifier of concept « Heart failure (disorder) »: SCTID 84114007. Because it is more specific than « Disorder of cardiac function (disorder), it is linked to it via a |is a| attribute. It is also defined by the attribute |Finding site| which is connected to the concept « Heart structure (body structure) » with SCTID: 80891009. A composedAttribute is defined for the attribute |Interprets (attribute)| connected to the concept « Cardiac function (observable entity) » which also displays the attribute |Has interpretation (attribute)| « Impaired (qualifier value) » as expected for a heart failure. Even if the sum of these facts can be large the fundamental logical structure is always in the form of a triplet «subject – predicate - object », here « concept – attribute - concept ».

### 3.1.2 Details

Another feature of the browser it to provide the different descriptions of a concept, besides the identifier and the FSN [Fully Specified Name]. From the United States of America English language reference set:

| FSN or Synonym | Term | Acceptability (US) |
|---|---|---|
| F | Heart failure (disorder) | Preferred |
| S | Heart failure | Preferred |
| S ✓ | Cardiac failure | Acceptable |
| S ✓ | Cardiac insufficiency | Acceptable |
| S ✓ | HF - Heart failure | Acceptable |
| S ✓ | Myocardial failure | Acceptable |
| S ✓ | Weak heart | Acceptable |

From the Belgian French language reference set:

| FSN or Synonym | Term | Acceptability (FR) |
|---|---|---|
| S | insuffisance cardiaque | Preferred |

From the Belgian Dutch language reference set:

| FSN or Synonym | Term | Acceptability (NL) |
|---|---|---|
| S | hartfalen | Preferred |
| S ✓ | HF - heart failure | Acceptable |
| S ✓ | cardiale insufficiëntie | Acceptable |
| S ✓ | hartinsufficiëntie | Acceptable |
| S ✓ | myocardinsufficiëntie | Acceptable |

### 3.1.3 Queries

SNOMED CT is formally defined and allows for complex queries using the Expression Constraint Language, currently in version 2.0. The SNOMED CT Browser offers to write or compose such queries in a specific language.
For instance, to get all the descendant concepts of type « Heart Failures », a simple query is:

> *<84114007 |Heart failure|*

which collects 121 concepts, including «Acute on chronic right-sided congestive heart failure (disorder)».
More complex queries can be formulated, such as:

> *<373873005 |Pharmaceutical / biologic product|: [2..4]762949000 |Has precise active ingredient|= **

which will return any « Pharmaceutical/biologic product » with 2 up 4 precise active ingredients.

# 4 PRE-COORDINATION & POST-COORDINATION

SNOMED CT already contains the largest set of clinical concepts, called « precoordinated expressions » that are immediately available for the health agents to manipulate. But sometimes it is not enough and to represent clinical phrases. If a single precoordinated concept does not capture the entire clinical phrase, SNOMED allows post-coordinated expressions combining several concepts.
For instance:

> *Laparoscopic removal of device from abdomen*

which does not exist as a precoordinated concept can be represented with:

> *removal of device from abdomen - using access device – laparoscope*

The expression in SNOMED CT:

*68526006 |removal of device from abdomen|: 425391005 |using access device| = 6174004 |laparoscope|*

# 5 MAPPING

SNOMED CT operates in an environment where other terminologies, nomenclatures, classifications exist and are in use. SNOMED CT is often used in conjunction with ICD-10 for diagnostic coding, where SNOMED CT provides detailed clinical information that enhances the broader categories defined by ICD-10. Similarly, LOINC complements SNOMED CT by providing standardized codes for laboratory tests and clinical observations, allowing for precise data exchange regarding test results. Mapping tools exist to map from and to SNOMED CT:

- Snap2SNOMED supports mapping to SNOMED CT by providing the ability to create simple maps collaboratively, with map review processes and map automation support. https://snap.snomedtools.org/
- SNOMED International mapping tool exists to support mapping from SNOMED CT to other terminologies including ICD-10, ICD-9-CM, ICPC and MedDRA. It supports the creation of simple and complex maps, revisions and quality assurance workflows. It provides a public directory and browser for the published map content but no map automation support. https://github.com/IHTSDO/OTF-Mapping-Service
- Other mapping tools exist in the industry, such as:
    - Rhapsody Semantic Terminology management tool promises auto-mapping based on an advanced multifaceted intelligent AI algorithm that evaluates thousands of concepts to find the best mapping match. https://rhapsody.health/solutions/terminology-management/
    - Snapper:Map, part of Ontoserver from CSIRO supports the direct creation of ConceptMap with no clear automation support. https://ontoserver.csiro.au/site/our-solutions/snapper/
    - SnoMAP Starter from SNOMED-CT-AU has been designed for mapping with ICD-10-AM encoded data but it is not clear if they can manage other classifications. https://ontoserver.csiro.au/site/technical-documentation/snomap-documentation/snomap-starter-development-documentation/
    - Snow Owl Terminology Authoring Platform offer automapping to provide candidates for mapping targets, from and to SNOMED CT. https://b2ihealthcare.com/
    - WCI SNOMED CT Terminology server from West Coast Informatics provide a full-service terminology mapping solution that includes automated mapping algorithms and human curation. https://www.westcoastinformatics.com/products/termserver
    - Transmed has been used in Belgium for the 3BT mapping with SNOMED CT and can integrate other sources and targets, including ICHI, ICF, ICPC-3. Coders have been using Transmed extensively, following parallel on sequential coding protocols. Coding helpers based on fuzzy mapping and AI can be plugged in to support the process.

# 6 RESOURCES

For more information, the official SNOMED International website (https://www.snomed.org) provides comprehensive information about SNOMED CT, including its structure, implementation guides, and

updates. It also offers access to educational materials and resources for health care professionals. The National Library of Medicine (NLM) (https://www.nlm.nih.gov) offers resources related to SNOMED CT, including mappings to other terminologies. National Release Centers also have the mission to support implementers of SNOMED CT and provide documentation and training sessions. https://smt.esante.gouv.fr/assistance/documentation-snomed-ct/formations-et-webinaires/

# 7 CONCLUSION

SNOMED CT is crucial in health care as it provides a standardized clinical terminology that enhances communication among health care providers. By ensuring accurate documentation of diagnoses, treatments, and outcomes, it reduces the risk of errors and misinterpretations, thereby improving patient safety. SNOMED CT also facilitates interoperability between electronic health record (EHR) systems, enabling seamless data sharing across various care settings. This standardization supports informed clinical decision-making, aids in tracking health trends, and contributes to research and public health initiatives. Overall, SNOMED CT plays a role in improving the quality of care and patient outcomes in health care systems.