Health Terminology Standard Review: SNOMED CT

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Modern medicine has allowed clinicians to push the boundaries of patient care, which has caused patients to become more complex; enormous amounts of complicated data are generated about these patients. Patients also often interact with multiple care providers, which requires the sharing of this complex data. The Healthcare Information and Management Systems Society (HIMSS) (n.d.) has defined the concept of Interoperability as:

> the ability of different information systems, devices and applications (systems) to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organizational, regional and national boundaries, to provide timely and seamless portability of information and optimize the health of individuals and populations globally (HIMSS, n.d., What is Interoperability, para. 1).

HIMSS further posits that Terminology Standards enable interoperability by providing a clear and unambiguous representation of concepts to ensure a common understanding by both the sender and receiver of information. The Systematized Nomenclature of Medicine–Clinical Terminology (SNOMED CT) is one such terminology standard. This report considers the history, key features, benefits, and challenges of SNOMED CT. An implementation of SNOMED CT in a healthcare setting is also explored.

Overview

SNOMED CT is a comprehensive, multilingual clinical reference terminology. The domain of SNOMED CT encompasses all aspects of clinical information, including diseases, symptoms, procedures, treatments, and other healthcare-related concepts (Bhattacharyya, 2016). Owned by the International Health Terminology Standards Development Organisation (IHTSDO), the primary purpose of SNOMED CT is the improvement of patient care, which can facilitate the generation of high-quality, unambiguous clinical data that can easily be shared. This standard aids clinicians in documenting information about their patients, such as their medical histories, medications, and diagnoses in an accurate and consistent manner. High-quality data can then be shared with other care providers in a way that ensures a common understanding and can be aggregated to enable population health analytics (IHTSDO, 2023, pp. 3–4).

Development and Maintenance

Benson (2010) describes the development of SNOMED CT as a merger between two products: SNOMED RT and The Read Codes, also known as Clinical Terms Version 3 (CTV3). SNOMED RT began as the Systematized Nomenclature of Pathology (SNOP), which was developed by the College of American Pathologists (CAP) and published in 1965. According to Benson (2010), “SNOP described pathology findings using four axes:

- Topography (anatomic site affected)
- Morphology (structural changes associated with disease)
- Etiology (the cause of disease) including organisms
- Function (physiologic alterations associated with disease)” (p. 183).

In 1975, SNOP was expanded to create the Systematized Nomenclature of Medicine (SNOMED), with version II released in 1979 and version 3 released in 1993. In 2000, through collaboration between CAP and Kaiser Permanente, SNOMED RT was created as a logic-based version of SNOMED (U.S. National Library of Medicine, n.d.).

Meanwhile, in the United Kingdom, a General Practice (GP) coding system (known as The Read Codes) was launched in 1986. The Read Codes were based on "the International Classification of Diseases, Ninth Revision for diseases, the British National Formulary (BNF) for drugs, the International Classification of Procedures in Medicine (ICPM), and the national coding scheme for operations OPCS-4" (Benson, 2010 p. 180). While the Read Codes were effective for General Practice, they were ineffective for hospital use due to their hierarchical nature, which mean that each code could be classified in only one way. In 1990, the Read Codes were purchased by the Department of Health, and in 1992, The National Health Service began a project to improve The Read Codes, resulting in a clinical terminology known as Clinical Terms Version 3 (CTV3). The first version of SNOMED CT was released by CAP in 2002. It was built "as a true merger: every Read Code and previous SNOMED code ever released were included" (Benson & Grieve, 2021, p. 296).

In 2007, the IHTSDO acquired SNOMED CT (including all versions) with the goal of promoting international adoption and use of the standard (U.S. National Library of Medicine, n.d.). IHTSDO, whose trading name is SNOMED International, owns, administers, and develops SNOMED CT with a focus on continuous quality improvement. Describing their quality improvement framework, IHTSDO (2023) maintains that:

> a documented scientific process is followed, and 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, the authoring team consult with additional experts to review the scientific integrity of the content (p. 38).

IHTSDO now releases an international edition monthly, and it is in use in more than eighty countries (SNOMED International, n.d.-b). Additionally, Canada Health Infoway, an independent not-for-profit corporation established by the Government of Canada, manages a Canadian edition of SNOMED CT that contains content tailored to Canadian use contexts, and contains CA French, CA English, and CA subsets. It is released four times a year in February, May, August, and November (Canada Health Infoway, n.d.).

Key Features

Bhattacharyya (2016) notes that SNOMED CT is composed of three foundational elements: concepts, descriptions, and relationships. Each of these elements is uniquely identified by a numeric SNOMED CT identifier (sctID), which is an integer between 6 and 18 digits long. The sctID do not provide any information about the element they represent (pp. 26–27). Elements also have associated *active* and *effectiveTime* fields. Elements are never deleted, if necessary, they may be inactivated by setting the active field from 1 to 0 (p. 71). Benson and

Grieve (2021) explain that the *effectiveTime* field indicates the date/time an element is created, or it reflects the date/time an element replaces an inactive element (p. 296).

Concepts and Descriptions

Snomed International (n.d.-b) explains that every clinical idea is represented in SNOMED CT as a concept and claim that the latest version of SNOMED CT contains more than 360,000 concepts, making its coverage very broad (para. 1). Bhattacharyya (2016) further indicates that concepts are unique: each clinical idea is represented by exactly one concept, and each concept represents exactly one clinical idea (p. 27). Benson and Grieve (2021) expand that these concepts are organized in a polyhierarchy, progressing from broad categories to more specific details, where each concept (subtype) can be associated with one or more parent (supertype). The root of the hierarchy is the SNOMED CT Concept, and there are currently 19 top-level hierarchies under the root (p. 300). The top-level hierarchies are subdivided into three groups: object hierarchies (i.e., clinical finding, procedure, and specimen), value hierarchies (i.e., body structure, organism, and pharmaceutical product), and miscellaneous (i.e., qualifier value and record artifact) (pp. 305–306).

Object Hierarchies	Value Hierarchies	Miscellaneous
Clinical finding	Body structure	Qualifier value
Procedure	Organism	Record artifact
Situation with explicit context	Substance	Special concept
Observable	Pharmaceutical product	SNOMED CT model
Event	Physical object	
Staging and scales	Physical force	
Specimen	Social context	
	Environment/geographic location	

Figure 1 The top-level SNOMED CT hierarchies (Benson & Grieve, 2021, pp. 305–306).

Benson and Grieve (2021) explain that each concept is represented by its unique SNOMED CT identifier (sctID) and two or more descriptions: the fully specified name (FSN) and one or more synonyms. The FSN is composed of the description with the semantic tag in parentheses, where the semantic tag indicates its primary hierarchy. The semantic tag is added because it is possible for two very different clinical ideas to be homonyms. For example, the term “cold” can be used as synonym for the idea of feeling cold (as in body temperature) and having a cold (as in an illness). The FSNs for these two concepts are as follows: *Cold sensation quality (qualifier value)* and *Common cold (disorder),* respectively. These synonyms are marked as preferred or acceptable, the preferred term being the common expression used by clinicians to denote a concept, serving as the default display term in a certain language or context. Synonyms are often added when there is more than one common term for a given clinical idea (i.e., heart attack and myocardial infarction are both used for the same clinical idea). Synonyms

are also added in different languages to support the multilingual nature of SNOMED CT (pp. 296–298).

Concept ID	Description	Description Type	Preferred or Acceptable
14669001	Acute kidney injury (disorder)	Fully Specified Name (FSN)	Preferred
	AKI - acute kidney injury	Synonym	Preferred
	ARF - Acute renal failure	Synonym	Acceptable
	Acute renal failure	Synonym	Acceptable
	Acute renal failure syndrome	Synonym	Acceptable

Figure 2 Descriptions for the Acute kidney injury (disorder) concept in the Canadian English Language Reference Set (Snomed International, n.d.-b).

Relationships

According to Benson and Grieve (2021), all concepts in SNOMED CT are linked to one or more other concepts through relationships. Several types of relationships exist, including subtype relationships, attribute relationships, and qualifier relationships (pp. 298–299).

Subtype Relationships

Subtype relationships, also known as "IS A" relationships, are the most common form of relationship in SNOMED CT. They are unidirectional and go from child (subtype) to parent (supertype). The meaning of the child concept is completely included within the meaning of the parent concept, while the opposite is not true. Each concept eventually rolls up through its parents to the root concept, which is called the "SNOMED CT Concept" (Benson & Grieve, 2021, p. 298). Concepts may have one or more parent, which provides SNOMED CT with its polyhierarchical nature. For example, the concept *Pneumonia (disorder)* has two parents, which are: *Infectious disease of lung (disorder)* and *Pneumonitis (disorder)* (NHS England, 2024).

Attribute Relationships

Attribute relationships, also known as "HAS A" relationships, help to define a given concept by linking it to the concept of a defining characteristic. There are many attribute relationships, such as Finding Site, which specifies the body site affected, and Causative Agent, which identifies the cause of a disease. For example, there is an attribute relationship of *Pathological process (attribute)* between the concept of *Pneumonia (disorder)* and *Infectious process (qualifier value).* In this example, the relationship is the attribute "Pathological process." It is important to note that not all attributes are allowed with each top-level hierarchy. For example, the *Clinical Finding* top-level hierarchy allows the attribute relationships *Finding Site*, *Associated Morphology*, and *Causative Agent*, but not *Method*. Meanwhile, the *Procedure* top-level hierarchy allows the attribute relationships *Procedure Site* and *Method,* but not *Finding Site* (Benson & Grieve, 2021, p. 299).

Qualifier Relationships

Qualifier relationships are used to refine or specialize a concept. Similar to Attribute Relationships, not all qualifiers are allowed with every top-level hierarchy. Some of the more common qualifiers include *Severity* (*Mild, Moderate, Severe, etc.*), *Priority* (*Emergency, Urgent, Routine, etc.*), and *Episodicity* (*First episode, Ongoing episode, New episode, etc.*) (Benson & Grieve, 2021, p. 299).

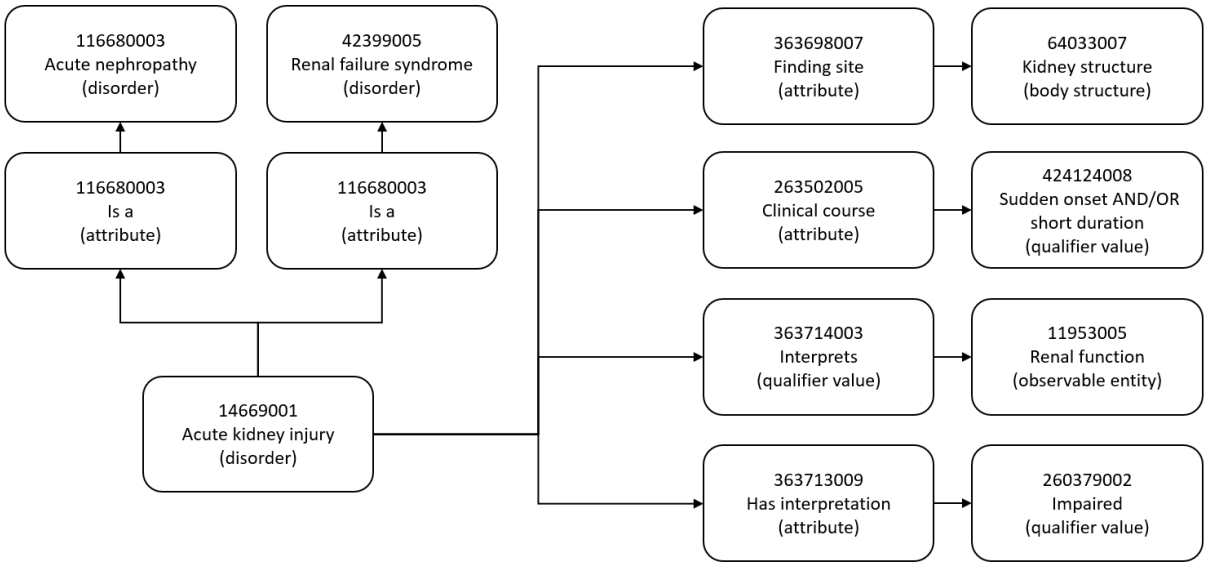

Figure 3 Relationships of the Acute kidney injury (disorder) concept (Snomed International, n.d.-b).

Benefits

Snomed International (n.d.-b) puts forward that SNOMED CT benefits individuals and populations and supports evidenced-based patient care. If all clinicians within a patient's circle of care have the same thorough understanding of the patient's data, the occurrence of duplicate procedures and adverse events can be reduced. When implemented in Electronic Health Record (EHR) systems, SNOMED CT enables clinicians to document data about their patients in a way that can easily be shared with and understood by others in the patient's circle of care (p. 4). Within the EHR, it also aids in the execution of clinical alerts that can provide real-time evidence-based advice to clinicians, further improving individual patient care (p. 4). SNOMED CT also aids in capturing patient data at an appropriate level of detail, which benefits populations through health analytics. Roberts et al. (2024) investigated the relationship between the level of specificity of pneumonia SNOMED CT terminology recorded and the accuracy of the predicted length of stay. They found that greater specificity led to better predictions.

Challenges

Snomed International (n.d.-b) recognizes the complexity involved in clinical terminology development and implementation. Clinical knowledge expands every day, which therefore requires constant updates to any clinical terminology standard (p. 37). Benson (2010) adds that the immense size of SNOMED CT creates challenges for its development, use, and maintenance (p. 160). For example, in their study, Shahpori and Doig (2010) explain that the breadth of SNOMED can make it difficult for clinicians to find the appropriate term; for example, their search for the term *Trauma* returned 1025 results (p364.e2). Chan et al. (2021) observe that the EHR user interface screens must be designed effectively for clinicians to choose the correct concepts when entering data about their patients. Roberts et al. (2024) also note that clinicians require education, and their buy-in is necessary to ensure that they document data about their patients with the appropriate level of specificity.

Implementation Example

University Hospitals Birmingham (UHB) National Health Service Foundation Trust in Birmingham, United Kingdom (UK), operates several hospitals and provides both secondary and tertiary healthcare services to the Birmingham area. A study was undertaken by Pankhurst et al. (2021) to evaluate the impacts of migrating a UHB EHR to the SNOMED CT coding system. The EHR in question, called Prescribing Information and Communication System (PICS), was developed in-house by UHB and utilized the International Classification of Diseases, Tenth Revision (ICD-10), for diagnostic coding: “Implementation of SNOMED CT coding into PICS was predicted to allow clinicians to more accurately enter detailed diagnoses, enable more complex CDS, and facilitate more accurate data collection, provided the tool was intuitive” (p. 2). A formal methodology was designed to assess the success of the migration, including surveys, interviews, focus groups, and email feedback. Data collection occurred during the timeframe of September through December of 2019. Since SNOMED CT is more detailed than ICD-10, 30,000 new codes were added to the EHR, and 15,000 of the old codes were mapped to new ones. To support the changes, a new user interface was also added. The project concluded with high clinician acceptability. Positive feedback included enriched data sets, improved standardized data collection and sharing with other clinicians, and improved patient care through use in safety rules. Negative feedback centered around the length of problem lists, especially when clinicians did not understand the meaning of synonyms.

Conclusion

The Data Administration Management Association (DAMA) defines data accuracy as “the degree to which data correctly describes the ‘real world’ object or event being described” and posits that data accuracy is a core dimension of data quality (2017, p. 457). This report has explored how the SNOMED CT terminology standard enables the capturing and sharing of accurate healthcare data to support evidence-based care for individuals and populations. It has also reviewed how the UK implemented SNOMED CT with positive results. Looking ahead, it is exciting to consider the additional positive impacts that SNOMED CT may bring in the future.

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