Clinical Terminology in Patient Health Record System - SNOMED CT Overview

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Abstract

Background of study: Patient Health Record System (PHRS) is used by physicians for capturing patient medical records in electronic media. Standardization in PHRS arises a major challenge due to its complexities. The used of clinical terminology is needed in order to facilitate more expressive clinical data input, provide unambiguous encoding and support the exchange of clinical information. One of highly specialized clinical terminology is SNOMED CT(Systematized Nomenclature of Medicine Clinical Terms) that able to encode clinical data, and contains concepts that linked to clinical knowledge to enable accurate recording of data without ambiguity. The aims of this paper is to discuss the use of clinical terminology in PHRS and identifying importance factors for applying clinical terminology in healthcare services.

Method: This study used review of literature in order to find the use of clinical terminology in patient health record system by reviewing current used of clinical terminology.

Result: The result of the study found that clinical terminology supports information exchange between healthcare providers.

Keyword: Patient Health Record System Clinical Terminology, SNOMED CT

INTRODUCTION

PHRS is slowly replacing the used of paper based documentation into an electronic document that used by physicians during consultation process in documenting patient clinical information, applying clinical finding, and reviewing the results and documenting disposition notes.[1] The patients' medical records have to be collected and maintained in standard format such as medical language that represented by standard clinical terminologies and classifications. Standard terminology is crucial for transmitting clinical data across diverse health information systems and to share between PHRS systems.[2].

The use of clinical terminology standards in PHRS represents information and communication process across medical providers to ensure effective storage of patients' medical records. While in particular, using standardization arises a major challenge in PHRS due to its complexities [3] be caused of most medical providers prefer to select items of clinical findings from simple lists rather than more complex structure of ontology.[2] An accurate and clear communication is important to facilitate the effectiveness of communication in the developed PHRS by providing coded concepts found in clinical terminology.[4] According to S. Bakken et al.[5]"an explicit terminology model defined as an explicit representation of a system of concepts that is optimized for terminology management and that supports the intentional definition of concepts and the mapping among terminologies".

Clinical terminology is an important prerequisite for making successful PHRS[6] and as the increasing use of PHRS, clinical terminology is needed for facilitating expressive clinical data input and widely used by healthcare providers.[7] Presently there are various terminologies that have been built by different institutions such as World Health Organization, National Library of Medicine, and College of American Pathologists. Yugyung Lee et al.[8] identified that the developed terminologies are used for different purposes such as literature indexing and retrieval, electronic patient records, statistical reports on mortality, billing, and applied in different subdomains such as diseases, genomes, micro-organisms, diagnoses, medical devices, procedures, and drugs.

Henry Wasserman et al.[9] Highlighted in their research that by applying standardized terminology allows diverse systems and applications among the

healthcare providers and supports efficient indexing and processing of patient data, and essential element for the implementation of knowledge-based clinical decision-support, data retrieval and aggregation. Thuppahi et al.[4] indicated that a challenge faced by most of medical providers applying PHRS is the use of non-standard terminologies across hospital networks and even across nations.[2] Li Zhou et al.[10] Stated that one of the solutions in solving unambiguous encoding and clinical information exchange is applying clinical terminology.

Clinical standardizations include clinical terminology and clinical classification. According to Sue Bowman,[7] both clinical terminology and clinical classification are designed for distinctly different purposes and satisfy diverse requirements. Clinical terminology, such as SNOMED CT, considered as an input system and codifies the clinical information captured in PHRS during the patients' consultation time. While classification system, such as ICD-9-CM, ICD-10-CM and ICD-10-PCSconsidered as output systems and are not intended or designed for the primary documentation of clinical care. It was noted that there are some lacks in classification system such as granularity, and complex rules for code selection.[7] This limitation became a reason supported the preference in using clinical terminology in PHRS.

THE USED OF CLINICAL TERMINOLOGY IN PHRS

PHRS is patient-centered clinical information resource supported by computer software and hardware infrastructure[11] in order to improve procedures, reduce the problems of paper-based patient documents, improve the quality of treatment, automate input requirements, and to improve quality control of patient's clinical information.[12]

Clinical terminology is required in sharing data and applications into diverse healthcare system [13] and it is important resource to any kind of healthcare information task such as coding, free text indexing, information retrieval, analysis of patient information, safety of patient care, public health monitoring, bioterrorism response, reimbursement and healthcare policy decisions.[14,17]

According to Yefeng Wang et al.[15] another reason the importance of clinical terminology is that the clinical notes contained patient's clinical information written in natural language and contains formal terminology used

in an informal and un-orderly manner. As such, these clinical notes need to be converted to formal terminology to enable accurate retrieval and to compile aggregated statistics of the medical care. Rosen bloom et al. (2006) highlighted that "terminologies consist of collections of words or phrases, called terms, aggregated in a systematic fashion to represent the conceptual information that makes up a given knowledge domain such as clinical cardiology or pediatric orthopedics".[16]

Bowmen [7] gave some criteria for clinical terminology in interacting within PHRS. Clinical terminology should be accessible and linked to medical knowledge for real time clinical decision support system. It should enable information exchange between healthcare providers thereby speed-up healthcare delivery and reduce duplication of testing and prescription. The available information would provide pro-active reminders such as allergy alerts, reminders for screening tests and notifications of potential drug interactions.

CURRENT MEDICAL TERMINOLOGY

There are many types of clinical terminologies used in healthcare services. In this paper, we will only compare three clinical terminologies: SNOMED CT, MEDCIN, and Omaha System. The following table shows the comparison of SNOMED CT, MEDCIN, and Omaha System as a terminology used in electronic documentation of patients' record.[17,18,19]

Table 1: Example of Current Clinical Terminology

Comparison	Clinical Terminology		
	SNOMED CT	MEDCIN	Omaha System
Developer	College of American Pathologists and National Health Service of United Kingdom	Mediacomp Systems Inc.	American Nurses Association
Terminology URL	http://www.ihtsdo.org/	http://www.medicomp.com	http://www.omahasystem.org/
Released	2002	1978	1998
Mapped	ICD-9-CM	CPT-4, ICD-9, ICD-10 and DSM-IV	N/A
Updated	Twice per Year	Twice per Year	The last book was published on 2005
Supported	Supporting Clinical	Supporting Clinical Information System	Supporting Clinical Information System

	Information System		
	Browser supported	N/A	N/A
	International standardization	International standardization	International standardization
	Systematized Nomenclature of Human and Veterinary Medicine	Systematized Nomenclature of Human	Systematized Nomenclature of Human

DISCUSSION

This section will discuss the overview, advantages and disadvantages of SNOMED CT.

SNOMED CT Overview

SNOMED CT is a clinical terminology which was built by merging, restructuring, and enhancing the previous SNOMED version RT (Reference Terminology) with the former UK Read Codes. SNOMED CT is developed by the College of American Pathologists (CAP) and Clinical Terms Version 3 (CTV3) developed by the National Health Service (NHS) of the United Kingdom. SNOMED CT maintained and distributed by the IHTSDO and considered to be the most comprehensive, multilingual healthcare terminology in the world. The intention of SNOMED CT gives a contribution to the improvement of patient care through underpinning the development of systems to accurately record healthcare encounters and to deliver decision support to healthcare providers. This contribution will affect to the patients' care, especially in their clinical information, because SNOMED CT provides more clearly describe and accurately record their clinical information, in building and facilitating better communication and interoperability in electronic health record exchange, and in creating systems that support healthcare decision making [20]. Ronald Cornet and Nicolette de Keizer[6] summarized the evolution of SNOMED CT that first was developed in 1965 that known as SNOP, followed by 1974, 1979, 1993, 1997, 1998, 2000, 2002 namely SNOMED, SNOMED II, SNOMED Version 3.0, LOINC codes integrated into SNOMED, SNOMED Version 3.5, SNOMED RT, and SNOMED CT.

SNOMED CT Components

SNOMED CT consists of three core components: concepts, descriptions, and relationship. Here are the reviewed of SNOMED CT components taken from Technical Reference Guide.[20,21]

Concepts

Concepts is a clinical meaning identified by a unique numeric identifier (ConceptId) that never changes unique human-readable Fully Specified Name (FSN). Concept consists of two components, concept granularity and concept identifiers. The more general concept will have coarser granularity or less granular and represent less clinical detail. In the opposite, the more specific concept will have finer granularity and represent clinical detail. Each SNOMED CT Concept has a permanent unique numeric identifier which is known as the ConceptId. The sequence of digits in a ConceptIdis the meaningless of any information about the meaning or nature of the Concept. The meaning of Concept is represented in human-readable forms by Descriptions and in a computer processable form by Relationships with other Concepts.

Description

Descriptions are the terms or names assigned to a SNOMED CT concept or a phrase used to name a concept. A unique DescriptionId identifies a description. Multiple descriptions might be associated with a concept identified by a ConceptId. There are three types of descriptions: Fully Specified Name, Preferred term, and Synonym. The purpose of the Fully Specified Name is to uniquely describe a concept and clarify its meaning. The Preferred Term is a common word or phrase used by clinicians to name that concept. A synonym represents a term that can be used to represent a concept in a particular language or dialect. Example of the description: Some of the descriptions associated with ConceptId 22298006:

- Fully Specified Name: |Myocardial infarction(disorder)| DescriptionId 751689013
- Preferred term: Myocardial infarction DescriptionId 37436014
- Synonym: Cardiac infarction DescriptionId 37442013
- Synonym: Heart attack DescriptionId 37443015
- Synonym: Infarction of heart DescriptionId 37441018

Relationship

Each concept in SNOMED CT is logically defined through its relationships to other concepts. Every active SNOMED CT concept has at least one |is a| relationship to a supertype concept. Relationships consist of two types, |is a| relationships and attributes relationships. |is a| relationship is also known as “supertype-subtype relationships” or “parent-children relationship”. A concept can have more than one |is a| relationship to other concepts. In that case, the concept will have parent concept in more than one sub-hierarchy of a top level hierarchy. Subtype relationships can be multi-hierarchical. Figure1 shows the example of |is a| hierarchy and Figure2 shows the |is a| relationships. |is a| relationships are the basis of SNOMED CT’s hierarchies.

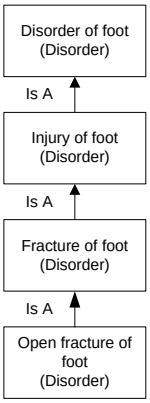

Figure1. example of |is a| hierarchy

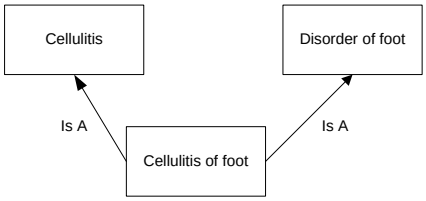

Figure2. shows the |is a| relationships

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 has a name (the type of Relationship) and a value (the destination of the Relationship). For example, the combination of the attribute relationships and |is a| relationships associated with a concept represents the logical definition of that concept. The logical concept definition includes one or more supertypes (represented by |is a| relationships), and a set of defining attribute 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)|.

Advantages and disadvantages applying SNOMED CT in Patient Health Record System

Some researchers have identified the advantages in applying SNOMED CT during doctor-patient encounter such as provide timely access, accurate medical records, detailed analysis of patient care, powerful evidence-based research projects and outbreak surveillance. In addition, the users are able to capture clinical findings by typing a key word of clinical terminology without understanding some of the basic terminology principles.[2,21] SNOMED CT covers such concepts as diseases, clinical findings and procedures, and has become a major standard in clinical research for representing a variety of clinical data [22,23], and provides the efficient indexing and processing of patient data.24

Elkin et al. [25] and Bowman [7] acknowledged that SNOMED CT is able to encode clinical data, and contains concepts that linked to clinical knowledge to enable accurate recording of data without ambiguity. SNOMED CT also effective to be used to index, store, and retrieve patient information for clinical purposes and make the data available to computer systems for clinical decision support, improved patient safety, and knowledge-based access to health information toward interoperable electronic medical records. [7,25] Clinical terminology is one of the important factors for the development of electronic medical records. Ronald Cornet and Nicolette de Keizer[6] found that SNOMED CT consistentlyable to indexing, storing, retrieving and aggregating clinical information and computerizing the medical record system.

Some disadvantages identified as the lack of SNOMED CT used in PHRS. Bryan Levy [2] informed that due to immense size, considerable granularity and complex hierarchies of SNOMED CT, it is not suitable for simplying interface terminology. SNOMED CT contains more than 300,000 concepts and 900,000 descriptions, could be overwhelming and exposing users. Hence, the users must be trained for effectively performing search and select items from the terminology database. Table 2 summarized advantages and disadvantages of SNOMED CT in PHRS.

Table 2:SNOMED CT Advantages and disadvantages applied in PHRS.

Advantages	Disadvantages
timely access, and accurate recording of data without ambiguity	immense size
detailed analysis of patient care	considerable granularity
powerful evidence-based research projects	complex hierarchies
effective to be used to index, store, and retrieve patient information for clinical purposes	Possible to overwhelmed and exposed users
Support to computerize medical record system	the users must be trained

CONLUSION

PHRS applied clinical terminology is able to be used in solving non-standard terminologies aimed to get more expressive clinical data. Clinical terminology supports information exchange between healthcare providers. SNOMED CT is one of highly specialized clinical terminology provide clear description and accurately recording clinical information, building and facilitating better communication and interoperability across health record system. However, SNOMED CT is not a simply interface terminology since its immense size and complex hierarchies. There were some other works that should be performed to improve the application of SNOMED CT in PHRS. Designing and developing a guideline for applying SNOMED CT in PHRS is important and highlighted things to do.

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