TBMI19-Medical Information Systems

Essay title:-

Health for me

Date: 2016-01-15

Linköpings universitet

Total Number of words except front page:- **2985**

Total number of pages except front page:- **6**

1. Introduction

Keeping individuals personal health information as paper copies have been a long tradition, and this has created problems related to organizing the data, retrieval of information and data interchange among the health professionals (1). Storing individual patient's health information in personal health record platforms can be one of the quality practices in modern health care centers. Personal Health Record (from now onward will be written as “PHR”) platforms allow individual patients to keep the record of, access as well as share their own health-related information (5). It was invented to address and solve the issues related to information sharing between the patient and caregivers, different electronic health records and handling health-related data in a secure manner (5). *Health for me [Hälsa för mig]* is also an electronic PHR platform that supports individual person or patients to keep their medical records and other important information so that to assist patients in health self-management.

1.1 Objectives

The main purpose of this essay is to investigate how the individual patient's health information can be stored inside *Hälsa för mig* platform in a structured way so that information can be transferred through the technical interfaces in a way that makes it easy for the caregivers to find the relevant parts in the transferred information.

1.2 Problem description

Patients should be able to share a specific part of their health information to a caregiver, and caregivers should not bother from receiving a huge amount of data while their need is a small portion of it. PHRs or medical records, in general, should adopt a structured format to store and organize information so that it can improve the quality of IR-information retrieval (both precision and recall) and shared at most in a productive way (5). *Hälsa för mig* is a PHR platform facing a similar problem with unstructured data management. For this essay work, I have formulated the following research question; How the data inside *Hälsa för mig* shall be stored? So that patients can share a specific information to caregivers, as a result caregiver will not get difficulties in reading the required information.

In section two (Theoretical background) of this essay, I will introduce some of the most important methods of structuring medical information, next, in section three (Discussion), I will suggest a prototype for the information structure by giving a brief discussion of the methods from the theory, finally, a conclusion will be given in section four (Conclusion).

1.3 Delimitations

This study is aimed at proposing a prototype that can help to structure the data stored inside *Hälsa för mig* platform. This platform can keep different categories of patient information, however, this essay will focus only in *heart attack disorders of healthcare data* as the information to be transferred and assumes that any possible data can be structured and transferred in a similar approach. The actual implementation of the prototype and its validation is beyond the scope of this

essay. To accomplish this essay, I have been specified into literature related to electronic health records in general and standards for terminology classification. The completion of this study has taken two months and ten days.

2. Theoretical Background

Patients health information can be stored in different records, and these records can be of different formats, such as PHR, and Electronic health records (EHR). PHR stores individual patient's health information, and the highest authority falls into the patient (5). The EHR also keeps a record of the patient's health information but it is under the control of the clinicians, i.e. all authorized clinicians have the right to access information (5). Even if there is an authority difference in accessing the information, but all are aimed at storing health information of the patient's. Besides to this, all are electronic and they share information among each other. There are several ways of classifying information stored under this platforms;

2.1 Terminology classification

2.1.1 SNOMED CT

SNOMED CT, Systematized Nomenclature of Medicine Clinical Terms, is one way or method of classifying medical terminologies (2). It is one of the most important and all-inclusive clinical terminologies that can be applied in any authorized electronic health record systems in order to structure, store and share patient health information. It plays a great role in the implementation of health record software by organizing and structuring health information in a reliable, stable and effective way. It indexes the content of the health information which makes it easy to retrieve and share health information with caregivers all over the world.

SNOMED CT arranges the information in three different components ; *concepts* (2) represent a unique thought of clinical meaning and are recognized by a concept identifier which is a numeric representation and uniquely identifies each concept. They are used to represent anything that could be useful to store in the record. *Descriptions*: (2) appear connected to the concepts above which gives more definition or expression of the concepts. A single concept can be described using three descriptions, I.e. *Fully specified name, Preferred term, and synonym*. Each description represents or refers only to one concept. A single concept id, for example, could have various synonyms to accommodate variations in name, for example, "*Myocardial infarction*" can be searched as "*Cardiac infarction*" or simply "*heart attack*". *Relationships*: (2)used to create concept to concept linkage which are similar in meaning. They can be different types, such as is-a or has-a, thus, "*is-a*" is the most common type of relationship among concepts. These partitions of SNOMED CT will improve the way that the data can be searched, retrieved, reused or analyzed in a variety of ways (8).

2.1.2 International Classification of Diseases

The ICD is the international standard to classify diagnostic diseases for managing health information. It is used to group diagnoses of diseases including various of diseases, *symptoms, abnormalities, and internal and external injury or disease* (4). Beyond its simple way of

classifying and storing diseases information, ICD also benefits us in the retrieval and analysis of the data in a systematic way (4). It can also be applied to structure and organize the data stored in health records by classifying the diseases and other health problems. It was originally invented for the purpose of classifying the causes of mortality. It is stored in a table format which is well indexed and provides an alphanumeric coding scheme up to six characters long with one letter followed by three numbers at the four-character level.

2.2 Health record structure

2.2.1 Problem-oriented Medical Record (POMR)

POMR is a method used to structure patient health information inside electronic health records recommended by Dr. Lawrence L. Weed in the late sixties (3). It helps to structure patient's data based on the *problem list* that the patient encounter. POMR basically groups the information in different sections. Initially, a *database* must be formulated in which all gathered data can be stored, and then based on the data captured, a *problem list* will be constructed. The list of patients problem will later be used as an index to the entire database. All necessary information that needs to be stored will be recorded under the list of problem that they fit. Every problem's progress will be followed under a *progress note* in a format called SOAP- Subjective (for storing symptoms from the patient's perspective), Objective (to store measurable symptoms and results), Assessment (will contain diagnoses from the caregiver point of view) and Plan (is for keeping record what the caregiver will plan to resolve the specific problem) (3).

3. Discussion

Information can be stored inside the PHR either directly by the patient (may be family member) or can be transferred from other platforms such as the EHR (5). Data stored inside PHR platforms must be structured in a similar way to other electronic health record platforms so that they can achieve consistency, and interoperability in communicating and sharing relevant information among different platforms and health professionals (5).

The terminology classification discussed above in the theory section can be a good start to classify the information inside electronic platforms that would hopefully result in effective use of information and simple way of sharing and retrieval of information. Thus, some of the standards for classifying medical terminologies shall be applied into our platform to achieve compatibility and interoperability with other electronic platforms and to get the advantages of national health information standards. However, not all classification methods might not be relevant to apply into our system, thus it is necessary to evaluate and choose the best.

The PHR platform may store various information one way or the other related to the individual patient. For example, personal information of the patient, list of problems such as allergies and chronic diseases, a list of treatments and medicines given-prescriptions, notes for every progress that the patient undergone and many more.

Once a particular patient creates a PHR account, the detail of his/her personal information should be registered. Next to this the health professional should take a complete history and a full physical

examination of the patient. Problems can come from any part of the database, history of present illness, past medical history, family history, social history, review of systems physical exam and laboratory studies. Observations combined from different parts of the database frequently become a part of a single diagnosis. This will help the health professional to make a list of problems that the individual patient has, and formulate the database.

Once all required patient information are gathered, and a database is formulated, the problem list will be compiled and constructed. This problem list will form an *index* of everything that is wrong with the patient. And it will serve as a *"table of contents"* of the PHR database (3). Nothing appears on the problem list that is not found some place in the PHR database and anything important in the PHR database goes onto the problem list. The order that problems are written on the problem list is not critical, however, it is a good practice to put them according to their importance. A problem list should contain verified evidence, defined in the highest understanding of the health professional. Compiling the problem list will ensure that nothing is overlooked and logical decision can be made while taking everything that is relevant into context.

The problem lists can further be classified as *active*- if the problem is still ongoing and requires an attention or *inactive* if the problem is already resolved which but, still needs to have in mind as it might affect the future problems that the patient will encounter. Dates, when the problem happened or resolved, are also important to document.

Apart from the patient's personal information, PHR's can store data related to the patient's family member which is relevant to the patient's health. Assume a situation in which a PHR is required to contact EHR for the reason of sharing information about spreading diseases in a family members. Thus, the patient should be able to specify the information that he/she would allow to share to the health record systems.

POMR allows this and all information resulted from an investigation including drugs prescribed should relate to a specific patient's problem and will be organized and stored in a format called SOAP. SOAP template is basically a way of keeping progress notes or follow-up notes to clarify or better manage something on a specific problem. In the *subjective* section, everything what the patient or family member tells or reports and what the health professional finds and consider as a problem will be stored. The *objective* section will contain the history of the patient's problem, laboratory examination and special test findings, its symptoms and what the patient feels about the problem. The third section, which is *assessment* will keep record of the thoughts, reasoning and conclusions of the health professional in relation to each specific problem. Finally, any plan made to help resolve the problem, such as prescriptions, advice, consultations will be in the *Plan* section.

3.1 Mapping the SNOMED CT

A PHRs that doesn't maintain interoperability among other health record platforms is said to be "*information islands*" (5) , this is because the platform doesn't support sharing of information and communication with other platforms and health professionals. In order to achieve interoperability, PHRs should follow the same standard of content encoding as the other electronic health records.

The problem list created above are the most important communication channel of the information under the platform, and it should be documented accurately and up-to-date (7). They are written at the level of highest understanding of the health professionals. Thus, a single patient problem might be defined in different ways by every health professional which could result in ambiguity. One of the biggest goal to achieve in proposing this model is to improve information retrieval (IR) in which to increase the relevant information returned. One method to increase the quality of IR is to lower the ambiguity. In this case, the ambiguity can be lowered by using concepts and this concept can be mapped from SNOMED CT terminologies. Concepts are keywords that play a great role in searching for a specific information. Encoding SNOMED CT into our problem list can help stakeholders (patients, caregivers and health record platforms) to speak the same information, to retrieve and share relevant information with caregivers and integrate them easily with other health record platforms.

Assume the patient problem list formed in POMR consists of several diseases and out of this the patient with heart attack is represented in the problem list using SNOMED CT, thus, SNOMED CT already represent as *Concept ID–22298006* **,** with its Fully Specified Name–*Myocardial infarction (disorder) (2)*. SNOMED CT describes it with P*referred Term – Myocardial infarction*, and synonyms– *Cardiac infarction*, *Heart attack*, *Infarction of heart*, *MI – Myocardial infarction*, and *Myocardial infarct (2)*.

Now out of the different patient's problem in PHR account, only the information related to heart attack shall be transferred into an electronic health record found in a different location, now instead of transferring the entire heart problem list, the user using EHR can search for the "Myoca*", "*Myocardial**" or any other combination which is near to the fully specified name of the concept. This will enable the user to retrieve all the information related to "*Myocardial infarction"* heart attack. Now, since all the retrieved information is related to heart attack, it would result in a good precision. However, the recall might not be good since the user lost other relevant information related with heart attack because the "*Myocardial infarction"* is not the only kind of heart attack. Thus, for better recall it shall be searched as (Myocardial OR heart attack).

Based on the above example, it can be deduced that, mapping of SNOMED CT terminology into the problem list record could benefit to improve the IR of a specific patient problem, and thus would result in simplifying communication among health professionals in the domain of the patient health record. A study has proved that SNOMED CT have the best coverage of clinical concepts (more than 98.5 %) compared to ICD families coding schemes (6, 7). SNOMED CT also allows the use of alternative descriptions more familiar to users without compromising ambiguity (6, 8).

4. Conclusion

There might be several reasons that, individual patients need to transfer a particular part of their health information into other platforms or clinicians. Similarly clinicians should not receive unnecessary information that they didn't request. Unstructured health information might results in consumption of cost, time, and energy during information retrieval. The POMR can play a grate role to organize the patient health information in PHR. As every patient is mainly concerned about the problem encountered, the proposed model has used a *problem-list* as an index that could

connect to the rest of information. The model did not present a detail structure for every possible data that can be stored in the platform, rather it gives a general overview how every single problem can be compiled and act as an index for its detail. Along to each *problem-list*, a SOAP template is included in order to separate between the follow up notes. The large amount of time required to compile and generate a *problem-list* could be a disadvantage of this model, as it requires the involvement of different health professionals and proper investigation of the patient's history. This analysis was also focused on the interoperability and consistency of the record. In order to remove problem-list ambiguity, improve the IR and transfer of information, a concept based ontology from SNOMED CT has been integrated into the system. Even though SNOMED CT has a better structure and coverage, it is still important the proposed model to support other classifications so that it can increase its diagnoses coverage.

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