OpenEHR Meets Interoperability and Knowledge Engineering

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ABSTRACT

Currently, implementing a new electronic health record data system is a rather difficult mission. Among some of the cons are the systems that already exist in institutions, different types of formats, programming languages and versions, user mentality, and resistance to new technologies. The new approach presented is based on an openEHR architecture that introduces a new way of organizing clinical information using valid and reusable clinical structures. This article focuses on the initial steps of the implementation of an openEHR system based on EHR in a Portuguese major health care provider. In all components presented in this approach, the mapping of the current systems in the healthcare institution is guaranteed. The system comprises operational template creation through a validation mechanism and after that storage, a platform for data generation dynamically constructed from templates and an interoperability mechanism through the implementation of an HL7 V3/CDA message system.

KEYWORDS
Archetypes, Artificial Intelligence, EHR, HL7 V3/CDA, Interoperability, OpenEHR, Operational Templates, SNOMED CT

INTRODUCTION

An Electronic Health Record (EHR) storages a large amount of medical data, data that must be available throughout the lifetime of a patient. Besides the effort and cost the solution must protect information when data loss occurs and at the same time be persistent and reliable across the years. The problem is often not the quantity of available data. Instead, the major issue is the fact that most of the information is made up to free text serving for nothing more than registering and consulting information.

The retrieval of relevant computer-aided information over the years has been increasingly automated and useful, with the primary goal of finding and recognizing standards for further classification of data. As a result, the generation of new knowledge increasingly supports decision

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making and reduces the probability of clinical errors occurring. All processing of large amounts of information, including historical and current information, as well as its classification, can often prove to be a time-consuming, painful and stressful process for the clinician, which may in some cases be clinically evaluated.

In Murdoch and Detsky’s view, in The Inevitable Application of Big Data to Health Care, quantitative, qualitative, or transactional data have been viewed as by-products or an accessory in health care delivery rather than being viewed as its epicenter to improve the efficiency of services provided. This thinking has to be progressively changed so that it is possible to use analytical tools and the discovery of standards and knowledge capable of assisting the clinical act in real time. The development of Knowledge Extraction Systems (KES) or Decision Support Systems (DSS), in this new era of knowledge discovery, the benefits of health organizations, are only possible if the clinical information is of the structured type. The authors mention that, in an industrial estimate, 80% of the data is in an unstructured format. This scenario resembles, to a certain extent, clinical data, not by the quantitative percentile, but by the size of what has yet to be transformed (De Maio, Fenza, Gaeta, Loia, & Orciuoli, 2011; Murdoch & Detsky, 2013).

This scenario has become a problem since information based on free text (unstructured data) is not stored in relational repositories, so it is obsolete for data analysis. It is of most importance to introduce new and innovative workflows of information inside healthcare organizations. These information circuits consider every moment since the insertion of data until the “final” consultation by doctors or clinicians. The moment where data truly becomes information. For such approaches to be possible, it is necessary for Healthcare Information Systems (HIS) to share information, that is, they are symbiotic and interoperable.

One of the solutions that are increasingly accepted and recognized worldwide is the openEHR standard, at the level of semantic interoperability. Since 2004, the openEHR foundation has published a series of design specifications for semantically interoperable and future-proof EHR systems. The main feature of the openEHR design is the separation between clinical concerns and technical design, the so-called, two-level modelling (Beale & Heard, 2007). The first level, Reference Model (RM), represents the technical concerns (information structure and data types). The second level of the model handles the clinical domains (representation of communication of the semantics) (openEHR Foundation, 2017). This enables the construction of stable EHR systems without specific clinical content necessary in different fields (Beale & Heard, 2007).

The use of archetyping in openEHR enables new relationships between information and models. An archetype stands for a computable expression of a domain in the form of structured constraint statements, so openEHR archetypes are based on the openEHR Reference Model (openEHR Foundation, 2017). These can be composed into larger structures called the templates (openEHR Foundation, 2017).

The purpose of the present document is to demonstrate the initial steps taken in the implementation process of an openEHR based EHR in a Portuguese major healthcare unit. The solution composes the creation of templates (modification of archetypes and translation), a system for validation and storage of the previous and the subsequent creation of web forms with basis on that operational templates. The system will also feature the generation and storage of information and exchange of information using HL7 Version 3 guidelines and HL7 V3 CDA. HL7 International specifies several flexible standards, guidelines, and methodologies by which various healthcare systems can communicate with each other. Such guidelines or data standards are a set of rules that allow information to be shared and processed in a uniform and consistent manner. These data standards are meant to allow healthcare organizations to share clinical information easily. Theoretically, this ability to exchange information should help to minimize the tendency for medical care to be geographically isolated and highly variable.

After the introduction, chapter two is entitled “Background” and is based on an intensive review of the literature on the theme, as well as, in the opinion of several authors, using them as motivations and strengths of the present work. Subsequently, the main chapter is presented as “System overview”
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