MEDINFO 2007
HISA Ltd Australia
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Child Leukemia Management System - A Pilot EHR Application Based on the *open*EHR Architecture

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Abstract

The openEHR foundation has developed an innovative design [1,2] for interoperable and future-proof Electronic Health Record (EHR) systems based on a dual model approach with a stable reference information model complemented by archetypes for specific clinical purposes

This paper presents an early implementation of openEHR specifications based on the requirement for a dedicated EHR to manage child leukemia treatment, which would enable an overview of all key data on given therapy and relevant observations.

It seems possible to build an EHR application with dedicated purpose on a generic EHR architecture. The two-level modelling and archetypes based EHR architecture seems to be useful for its potentials to improve EHR interoperability and sustainability.

Keywords:

Electronic Health Records, archetypes, *open*EHR, child leukaemia

Introduction

The collaboration with the pediatric oncology department of the Karolinska University Hospital, Sweden was started in 2004 to investigate a new type of IT solution for the management of chemotherapy for children with Lymphoblastic Leukemia in maintenance stage. We selected to test the two-level modeling approach, developed by the *open*EHR foundation and also the basis for the new CEN and ISO 13606 EHR communication standards. Such systems are totally configurable by the clinical content specifications, a.k.a. Archetypes, therefore very adaptive and sustainable.

However, when this project was started there was no previous implementation of *open*EHR in the Java programming language which we wanted to use for several reasons. We therefore had to start by the implementation of all of the core specifications of *open*EHR before we could build the specific leukemia application with its user and other interfaces. This implementation of the *open*EHR specifications later became the reference implementation in Java as reported elsewhere [3].

Methods

The system was implemented in Java programming language and built according to the design specifications from *open*EHR, namely the Reference Information Model (RM) and Archetype Model (AM). Since there was no existing Java implementation at that time, the team started from scratch and made initial implementation of the RM, AM and Archetype Language (ADL) parser. A layered approach has been used in the system design (Figure 1).

The presentation layer of the application is web-based. It is based on an open source Web application framework called Maverick [4]. The screen forms are generated using XML from the application with XSL transformation.

The business layer consists of two sub-layers, one generic EHR services layer and the other more Leukemia treatment related and less generic application specific layer. The generic EHR services provide common features that are necessary for any serious EHR applications for managing health records with considerations on, e.g. security and clinical terminologies.

The clinical requirement specific to Child leukaemia treatment management are modelled as archetypes, which contain detailed knowledge on how to represent observations necessary for monitoring patient that is undergoing chemotherapy in leukaemia maintenance stage. These include list of lab investigations, observation on adverse events, evaluation by the clinician, and finally medication about oral chemotherapy.

The persistence layer utilizes an Object-Relational Mapping tool called Hibernate [5] and a Relational Database Management System product MySQL [6]. The system is deployed as a J2EE application on a JBoss Application server [7].

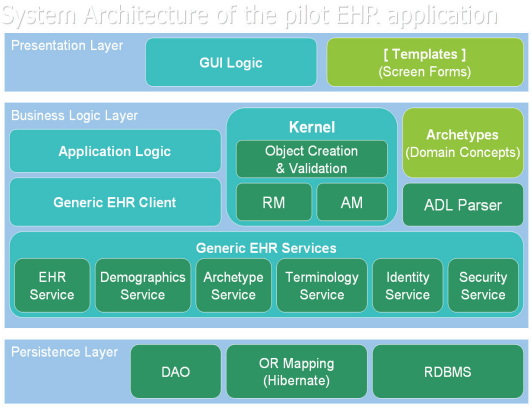

Figure 1- System Architecture of the pilot EHR application

Results

The Leukemia management system has been developed and is currently in the test phase. It records both demographic and clinical data for child leukemia treatment management. It renders all the information for a given patient and time period to a table or a diagram which gives the doctor an overview facilitating adjustment of oral chemotherapy. The clinical part of the system is totally driven by a Leukemia treatment archetype. Major part of the software has been donated to the openEHR Foundation and adopted as the Reference Implementation in Java [3, 7]. The implementation experience has been summarized in the openEHR Java Implementation Specification [8].

Discussion

The two-level modeling and archetype based EHR architecture used by this EHR application seems to be useful. It makes the system adaptive towards clinical requirement changes therefore more sustainable [9]. The separation between EHR system and EHR representation also improve the EHR interoperability [10]. But it also poses new challenges, e.g. term bindings between EHR data and external terminologies [11] and auto-generated screen forms based on archetypes [12, 13].

Conclusion

The fact that the Leukemia treatment management system is built on top of the *open*EHR architecture components proves that it is possible to build domain specific EHR applications in Java based on the generic design of *open*EHR with the two-level modelling approach. This work also led to the launch of the *open*EHR Java Reference Implementation Project and release of the core components as open source.

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