Bringing Electronic Patient Records into Health Professional Education: Software Architecture and Implementation

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Abstract. This paper describes the implementation of an Electronic Medical Record (EMR) which has been redesigned specifically for the purposes of teaching medical and other health professional students. Currently available EMR software is designed specifically for use in actual practice settings and not for the needs of students and educators. The authors identified many unique requirements of an EMR in order to satisfy the educational goals unique to the electronic medium. This paper describes the specific architecture and many of the unique features of the EMR implemented for the University of British Columbia (UBC) Medical School program for teaching medical students. This implementation describes 200 participating students participating in a hands-on use of an EMR with a single standardized patient case. The participating students were distributed across three physical sites in the Province of British Columbia UBC curricula in December, 2007.

Keywords. EHR, EMR, EPR, PHR, education, medical education, nursing education, health informatics education, biomedical informatics education, adoption

1. Introduction

In 2000, the Canadian federal government formed Canada Health Infoway (CHI) with an initial investment of $1.2 billion. CHI’s mandate was to accelerate and enable the growth of the information technology sector in healthcare. Their efforts have gained considerable momentum over the last several years. CHI’s mission is to foster the creation and adoption of an Electronic Health Record (EHR) substantially across the country by 2009 [1]. CHI collaborated primarily with provincial and territorial jurisdictions in a joint venture sharing in the cost. The scope of the federal initiative, due to cost constraints and prioritization did not include funding for computers in every physician office. Recently, however, many provinces and territories have bridged this gap by making their own provision to fund EMRs in private physician offices. Notably, in March 2006, the British Columbia government negotiated substantial funding to provide EMRs in physicians offices [2]. This funding was an integral part of the province’s investment in the overall eHealth framework [3, 4]. The incentive to enable
information sharing among providers, to avoid duplicate or unnecessary tests and to reduce medical errors [5, 6]. Having an EMR to provide clinical guidelines and decision support, it is expected that improvements in the quality of care can be achieved in a cost effective and sustainable manner [7]. With its high level of commitment in eHealth, the British Columbia government also announced special funding for teaching our future health care providers the new tools of their trade. The University of Victoria (UVIC) in British Columbia has over 25 years of experience in health informatics and was given the opportunity to architect and assist in the implementation of an EMR into the University of British Columbia (UBC) medical teaching program for their final-year students. Currently, the design and use of EMRs in health professional education is in its infancy. A recent review found fewer than 50 articles describing their use in medical education [8]. Some implementations have focused on teaching EMR fundamental concepts only [9], whereas others have attempted to integrate an EMR in the family practice setting [10]. There were no implementations currently reported to have introduced an EMR into a didactic problem-based teaching program. The education of future health providers in the use of EMR technology is sadly lagging actual implementations [11]. A review of the current commercial and non-commercial systems revealed very few options. Non-commercial systems lacked basic functionality. Commercial systems were too costly and designed to operate in actual practice settings only. All systems lacked the ability to create a preset or standardized patient that a number of students could access and change. Furthermore, off the shelf solutions are not designed to compare individual student responses.

2. Method: Requirements Gathering

The authors in May 2007 initiated discussions for designing an EMR to suit the needs of health professional educators and students. The specific requirements were determined through a series of teleconference meetings with University of Victoria (UVIC) and UBC faculty staff. There was agreement that an educational EMR should have a generic look and feel similar to a commercial system. Further, there was a requirement for the EMR to have the capability of mapping the unique and specific roles of students and educators. The educator should have the ability to construct a standardized patient case with a specific clinical scenario in addition to being able to view each individual student’s response to the standard case and clinical scenario. Whereas, the student should have access to their own private EMR work space without affecting other student’s workspaces, the ability to store and view a private copy of the standard patient case and any of their inputted changes. The authors reviewed currently available software and none were suitable based on the requirements agreed upon above. A decision was made to customize our own system. This comprised of starting with a generic object-orientated EMR developed by the authors’ using the Microsoft .NET framework. The generic EMR of the authors’ (Anthrologix EMR) was adapted to include new role-based query filters providing the unique educator and student requirements described above.
3. The EMR Case

The EMR teaching occurred during the second week of December 2007 and was part of the problem-based learning course for the UBC final year students. The standard EMR case was a hypothetical patient named Tom Miller a 45-year-old male presenting with a history of back pain with a complicated clinical course eventually requiring surgery. Prior to student hands-on keyboard experience, an introductory course consisting of basic information relating to EMRs was followed by a software demonstration. During the course of the week, small student groups shared a number of laptops with the EMR software installed. The laptops were distributed among three teaching sites. A step by step manual was provided to the students. The EMR exercises included: entering an encounter, performing disease coding, populating a problem list, requesting a consultation from an orthopaedic surgeon, retrieving both imaging results and a hospital discharge summary.

4. Software and Implementation

The proposed software implementation at the initial meetings were to deploy a system within a framework consisting of a centralized database where clients [the students] would log into the EMR, or a client-server model. This framework has been used successfully at other sites [12, 13]. Unfortunately, during the technical and connectivity requirements discussion, there were barriers identified which prevented this type of implementation. This was chiefly due to the disparate nature of the three sites. The UBC course spanned three physical sites and not all of the students had equal access to computers from which to access the EMR. Some students were located at hospital sites while participating in clinical electives where their hospitals restricted access to external applications including the Windows Remote Desktop application, which was the intended means of accessing the central database. A web browser solution was not immediately possible as the authors’ EMR was application-based and not web-based. The client-server approach was therefore abandoned and the EMR software was installed onto a number of laptops instead. A supplemental option of downloading the software into the student’s home computer was also offered through the UBC educational portal. This portal also contained the user manual for the EMR. The preexisting EMR graphical user interface (Figure 1) was utilized with minor modifications. This consisted of adding a new visual tab to expose a control panel for students and another for educators. The control panel for the students would provide the means to subscribe to a specific case (Tom Miller in this implementation) and to keep track of all cases subscribed to. The panel for educators provides the means to create one or many cases in addition to setting up the conditions in which the events of the patient case would appear (or simulation features, as described below).
As referred to above, a special user mode was added to the generic capabilities of the authors’ EMR allowing for different behaviors for students to those for educators. The special user mode enabled the EMR to distinguish the type of user whether a student or educator and behave accordingly. Students would access to their personal work space, to view and make changes to their own patients. Educators would be able to create a new patient case for publication allowing students to subscribe to them. A student subscription creates a separate copy of the patient case and stores it in their private work space. Educators when building a case also have the capability of simulation by controlling patient events as they unfold over time. For example, in the Tom Miller case, an imaging report would not be revealed until a later time. The educator can control when each event appears by setting the “Appearance Day” attribute. As the case unfolds over time, patient events reveal themselves to each student’s subscription. This feature provides the ability for the EMR to create a realistic time-sequenced simulation. Although not implemented for this student group, complex simulation scenarios can be easily created using our modified EMR by triggering different events based upon different student actions. Furthermore, real-time polling of student responses is possible allowing for possibilities of comparison, evaluation and quality improvement feedback.

5. Conclusion

The purpose of the initial implementation was to deliver this form of technology into the teaching program not done so in the past at the UBC site. There was high risk of failure due to the logistics of implementing software of this complexity. While the
initial tested implementation used a client-server model, freestanding local installations on laptop computers were used. Subsequent to the work reported in this paper, a web-accessible version of the EMR has been deployed which allows for such simultaneous access. This implementation was considered a success. The software was stable and did not cause install and execution problems. Preliminary and informal feedback from the students and educators was good. The EMR user interface was considered by both groups to be intuitive enough for use after the introductory learning session. Fortunately, technical issues never appeared as a foreground issue. The intent of the education experience was achieved spending the majority of the time discussing the patient case and how an EMR can document and facilitate care. The next step we are currently undertaking is to develop an evaluation framework for student performance as well as designing a framework to obtain formal feedback (from both students and educators) in order to improve the software and implementation for future courses. In addition, the use of the EMR described in this paper will be extended to a project involving inter-professional team training, using the EMR as an organizing resource to structure interactions among medical, nursing and other health professional students.

References