Requirements for Prototyping an Educational Electronic Health Record: Experiences and Future Directions

Andre KUSHNIRUK[a,1], Elizabeth BORYCKI[a], Mu-Hsing KUO[a], Eric PARAPINI[a], Shu Lin WANG[b] and Kendall HO[c]

[a] School of Health Information Science, University of Victoria, Victoria, Canada
[b] Department of Information Management, National Taichung University of Science and Technology, Taichung, Taiwan, ROC
[c] Faculty of Medicine, University of British Columbia

Abstract. Electronic health records and related technologies are being increasingly deployed throughout the world. It is expected that upon graduation health professionals will be able to use these technologies in effective and efficient ways. However, educating health professional students about such technologies has lagged behind. There is a need for software that will allow medical, nursing and health informatics students access to this important software to learn how it works and how to use it effectively. Furthermore, electronic health record educational software that is accessed should provide a range of functions including allowing instructors to build patient cases. Such software should also allow for simulation of a course of a patient's stay and the ability to allow instructors to monitor student use of electronic health records. In this paper we describe our work in developing the requirements for an educational electronic health record to support education about this important technology. We also describe a prototype system being developed based on the requirements gathered.

Keywords: Electronic health records; educational systems; health education.

Introduction

The adoption of health information is rapidly increasing. In particular, electronic health record (EHR) adoption is rising globally. Health professionals are expected to interact effectively with these technologies and understand both their benefits and limitations. However, it has been repeatedly reported that education about these technologies in health professional programs may not be keeping up with their increasing deployment in the real world [1,2]. To address this issue, researchers at the School of Health Information Science at the University of Victoria have created a Web-based platform for deploying a variety of EHRs and related technologies for educational purposes [3]. This Web portal has allowed various health professional students, including medical, nursing and health informatics students to remotely access and interact with a range of systems that are being made available using the WWW. In a number of projects, these technologies have been integrated into course and class work. For example, in one pilot project we focused on integrating EHRs into problem based learning for medical

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[1] Corresponding Author: Professor Andre Kushniruk - Email: andrek@uvic.ca

students. In doing so, the curriculum was enhanced by requiring medical students to obtain the "patient problem case of the week" using an EHR (instead of using paper records) which was remotely accessible through the educational electronic health record portal. In addition, during class time students were introduced to key features associated with EHRs, such as standardized coding and integration with clinical decision support. In this work it was found that by bringing information technology directly into education about patient problems, students could learn about both biomedical issues in the context of exploring patient cases within an electronic health record [3]. In addition, this research led to modification of open source electronic health records used in education by nursing students and health informatics students. The intent of this work was to provide students with hands-on exposure to EHRs.

Introducing health professional students to EHRs will be essential in order to help them cope with their practice upon graduation. Although this need has led to new ways of integrating health information technology in health professional learning, including EHRs, there are often aspects of electronic health records that the educators involved want to modify, change or enhance in order to better support educational processes and student learning [4]. For example, course instructors indicated that they wanted the ability to easily enter dummy patient case data into electronic health records used by students for learning. [5]. In this paper we describe our current work in developing the requirements for such systems and for creating an initial prototype based on our requirements analyses. The initial target group for the prototype described in this paper is health informatics students, but the same EHR is also targeted to be employed for educating medical and nursing students about health information technology. The learning objectives are to facilitate students in gaining hands-on experience with EHR technology, in the case of health informatics students to learn more about the technological aspects of system use. For health professional students the approach can be integrated into other methods such as problem-based learning [3].

1. Requirements for an Educational EHR

Based on our earlier work [5,6] in developing EHRs for educational use, a number of features and functions were identified as being potential features of an "ideal" educational EHR. For example, from our work in integrating EHRs into a course designed to teach medical students how to take patient histories, it was found that introduction of the full range of commercial EHR features was neither wanted nor desirable for this type of educational application, as having the full set of features enabled detracted from learning about note taking. This work was based partly on results from conducting interviews with both students and faculty who used a prototype educational EHR, as well as from review of the literature. As a result, one of our identified requirements was to design a system where certain features (e.g. use of decision support capabilities) could be "turned off" until needed in the curriculum [6]. One of the most desired features from all of our pilot projects was the need to have an authoring tool that would allow instructors of courses to pre-populate the student's EHR data space with dummy patient health data. This has been problematic with commercial EHR systems not designed to allow for this, as well as for open source systems, where even this type of feature is not always easy to program in [6]. In addition, the capability to freely add new features as "overlays" to the underlying EHR being used for education is highly desirable. From the instructor's perspective, the

instructor's "view" should be able to allow course instructors using EHRs to do the following: (1) enter dummy patient case data that students can access, (2) set up logging of student activities (i.e. using a log file that would for example track student access to system features and functions), (3) allow for summary of student activities and quiz results, (4) allow for setting up quizzes and tutorials, both to access students' health knowledge and ability to use the EHR technology itself. Additionally, the ability to set up a bank of patient cases that can be drawn from for creating student exercises and simulations is desirable. From our prior work, a desired feature was to provide a way for instructors to release key pieces of health data (e.g. consult reports, lab results etc.) over time to create a more realistic experience and simulate a patient's course for the student [5]. From the students' perspective, the EHR should be able to allow students to receive educational material and advice that is integrated directly into the educational record, and that allows for student quizzes and feedback (both about health information contained in the record and about using the EHR features themselves) [6]. Students should also be able to select from different patient cases to explore using the EHR and there should be built in tutorial features to illustrate use of different parts of the EHR.

From a technical point of view, ideal features include ability to run the educational EHR without instructors having to deal with complex system installations. To deal with this, as described above, we have created a Web portal that hosts varying EHRs that are accessible over the WWW. To do this we have leveraged our technical work and have allowed not only University of Victoria students to access the EHRs but have also provided the link to other educational programs. Other ideal capabilities included: (1) the ability to work on different platforms – mobile, tablets, laptops, desktops etc., (2) the ability to be easily customizable, (3) the ability to illustrate different user interface styles, (4) the ability to integrate with decision support tools and other applications, (5) automated logging capabilities. From a technical point of view, we are also working on moving our portal-based approach running on servers that are maintained at our university's data center to a more general cloud-based solution, where the EHRs will be available remotely on the "cloud". In addition, from a design perspective, we have concluded that new features that are added should become part of a toolset, that are general enough that they could be integrated with a variety of different underlying EHRs, in which these features could be easily added (rather than tightly embedding them within a specific system).

2. Design of an Educational EHR Prototype Based on the Requirements Analyses

Based on the requirements of an ideal educational EHR described above and on our prior experiences in developing and working with educational EHRs we have developed a prototype educational EHR that embodies a number of the key requirements as described above. The underlying EHR was programmed using Oracle APEX ® and uses and Oracle ® database and has all the features of a working clinical EHR, including all the basic functionality for entry and retrieval of patient medications, procedures, diagnoses, images and treatments. Figure 1 shows an example of the user interface of the prototype where an instructor has logged into the EHR to enter a patient case (using a case entry form) that will be automatically uploaded into the profiles of all students who will be interacting with that case. The interface allows for entry of patient information that will populate the students' EHRs when they log in.
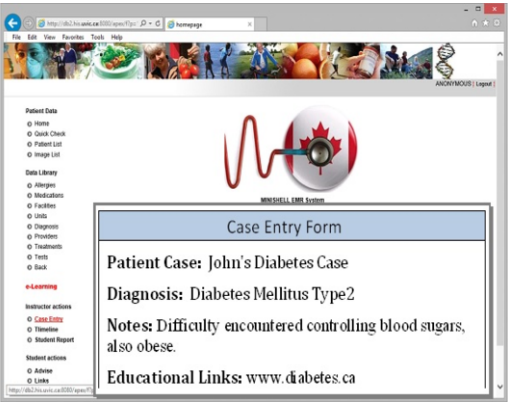
Figure 1. Instructor view: patient data entry

Figure 2 shows an example of the user interface (as seen in the instructor view) where the user (e.g. a professor) has logged in and is creating a time-line that will control the deployment of information to students about the case they are studying (i.e. "John's case of diabetes") over a three day period. This timed release of information to students allows instructors to create realistic simulated patient cases over time.
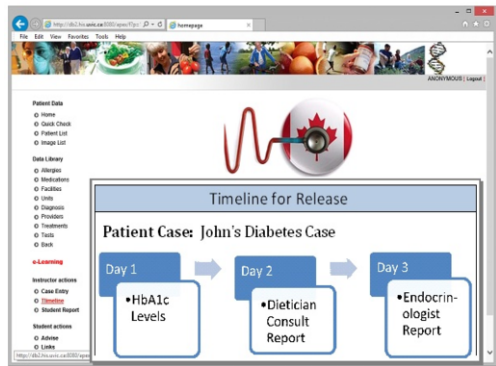

Figure 2. Instructor view: timeline for data release

Figure 3 shows an example of the user interface as seen by a student who has been using the EHR. In the figure, a pop-up window has been triggered that presents the
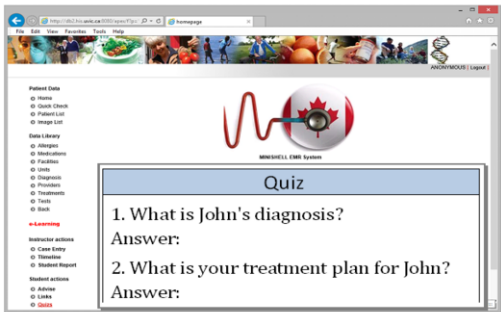

Figure 3. Student view: quiz

student with a quiz about the patient case they are studying. It should be noted that such tutorials can be embedded into the educational EHR, making the tutorials more realistic as they are presented in the context of interacting with a real EHR and its associated patient data (instead of interacting with "stand-alone" tutorials).

3. Discussion and Future Directions

The work described in this paper describes our efforts in moving from requirements for an educational EHR to development of a prototype system designed to embody the ideal features from the requirements. This work is on-going and we are currently extending the prototype design to include features such as the ability of instructors to block EHR functions to allow for a "training wheels" approach to presenting the EHR to students. Our current work also includes plans for conducting usability testing of the prototype system with students and instructors. From our prior work we have learned that a number of features and functions are needed in order to create software that is both realistic and that also contains features that facilitates use by students and instructors. In addition, we are exploring integrating tools and services associated with learning management systems (LMSs) within the EHR, including scheduling, learning boards, learning portfolios, blogs and web 2.0 [7]. This will include access to educational resources such as case studies and training videos accessible from within the EHR. We are also working on moving the system from a local server to a cloud-based solution, where the EHR and its associated learning resources will be made available through the cloud. This is expected to facilitate ease of system deployment .

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