Integrating Electronic Health Records Into Health Professional and Health Informatics Education: A Continuum of Approaches

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SUMMARY. There is a need to update and modernize health professional education to expose students to the latest health information technologies in their training and education. In particular, the electronic health record (EHR) promises to modernize and streamline healthcare. There are many programs internationally that aim to deploy these systems on a wide scale for all health professionals (including doctors, nurses and health informatics professionals) to use. However, the issue of how to train both health professionals and health informatics students about electronic health records has been problematic. In this paper we first provide a framework we have developed for guiding our educational efforts in integrating this type of information technology into education. We then describe a Web-based portal developed at the University of Victoria designed for remotely providing health professional and health informatics students with ubiquitous access to a range of electronic health records. The portal has allowed us to explore integration of electronic health records into health professional and health informatics education in a number of ways on a variety of educational projects to date. **Keywords: EHR, electronic health record, integration, education, health informatics**

1. INTRODUCTION

The electronic health record (EHR) and related technology promise to revolutionize healthcare practice, making it safer and more efficient [1]. Currently, there are many projects both nationally and internationally aimed at increasing adoption of electronic health record systems [2]. The EHR itself integrates information from several health information systems including electronic medical records (EMR), electronic patient records (EPR) and personal health records (PHR) [3]. However, despite considerable spending in this area, in North America, as well as in many parts of the world, the use of these technologies by health professionals has been problematic and there are many issues around improving adoption and proper use of these systems. For example, recent studies have indicated that less than 25% of physicians use EMR's the United States [4]. In some parts of Europe physician EMR adoption rates are higher (greater than 95% of primary care physicians in some European countries such as Denmark and Sweden use EMRs) [5] yet paper continues to be generated and used by physicians in their offices. EPR adoption rates world-wide continue to remain low, and issues regarding problems in adoption have been reported internationally with the description of implementation failures. As a result, many hospitals continue to use paper and hybrid paper-electronic patient records rather than full EHRs [6].

There are many reasons for the difficulties associated with implementing electronic health record technology widely, including the complexity of such systems, health informatics personnel shortages, organizational issues, the need for local and national coordination between governments, usability issues and issues related to interoperability [7,8]. In this paper we will focus on an area that the authors argue will be essential to address (in order increase adoption of electronic health records) but that has remained to be fully explored in the literature. More specifically, there is a need for research into understanding how health professionals' (e.g. medical, nursing, health informatics and other health professional students) exposure to different EHRs during their education and training could help them understand the

advantages and issues related to this important technology which they are expected to adopt upon graduation [9]. Such early exposure (i.e. during a health professional's formative undergraduate education) is key to health professional's developing a certain level of comfort with using the technology in real-world settings after they graduate and go on as health professionals. In addition to this, from a health care systems perspective such early exposure to the use of EHRs in healthcare settings would: (a) reduce overall training costs as these health professionals would have already gained sufficient experience with differing types of EHRs with differing design metaphors to draw on past experiences when learning to use a specific type of EHR in a given health care setting, and (b) improve adoption rates of EHR's (as health professionals would have had the chance to use the technology and assess its ability to support their practice [10]). Along these lines, this paper describes work we have conducted in: (a) developing a guiding framework for integrating electronic health records into health professional education (b) developing a Web-based portal that will allow for health professional students to access and experience a range of records over the WWW, and (c) examples of our efforts in integrating the use of this portal into the training and education of a range of health professional students (applying the framework developed to guide our efforts).

2. BACKGROUND AND MOTIVATION – ISSUES IN INTEGRATING ELECTRONIC HEALTH RECORDS INTO HEALTH PROFESSIONAL EDUCATION

There are a number of reasons for developing new approaches to supporting the integration of electronic health records into health professional education. Firstly, we expect graduates of health professional programs to be able to practice effectively in the changing healthcare environment, including having the capability and knowledge to be able to use information technologies in their practice. Secondly, graduates will become consumers of new health information technologies, so they should have the knowledge to be able to compare different EHR products regarding their capabilities and their match to their practice. However, there are a number of logistic issues in bringing technologies such as the EHR to health professional education and practice. These include the following: (1) an international shortage of health informatics specialists to technically set up, maintain and customize electronic health records for educational purposes, (2) the need for health professional students to have exposure to multiple types of systems in variety of different educational contexts, and (3) the need for guiding educational frameworks to support the integration of electronic health records in health professional education. Other issues include the need to integrate education about electronic health records in a way that is time effective and is integrated into health education in a seamless and effective manner that effectively exposes students to technologies such as EHR without taking time and emphasis away from the teaching of the health professions [9,10].

In this paper we will focus on the educational issues involved in creating a conceptual framework for integrating electronic health records into health professional education (e.g. medical, nursing, health informatics and allied health professional training and education) as this is an essential technology that is expected to change and modernize healthcare worldwide. We will then describe a technical platform we have created for experimenting with the integration of electronic health records into health professional and health informatics education.and allied health professional training and education) as this is an essential technology that is expected to change and modernize healthcare worldwide. We will then describe a technical platform we have created for experimenting with the integration of electronic health records into health professional and health informatics education.

3. TOWARDS A FRAMEWORK FOR INTEGRATING EHRS INTO HEALTH PROFESSIONAL AND HEALTH INFORMATICS EDUCATION

In considering how best to integrate education about health information technology into health professional education, we have developed a framework for such integration and for guiding educational initiatives aimed at integrating EHR technology into health professional education [11]. In our framework we consider integrating EHRs (and related information technology) into health professional education along a continuum ranging from loose coupling of the technology with the educational curricula, to tight coupling of the technology with the educational curricula. In our framework "loose coupling" refers to an informal or a weak level of integration of the EHR into course work and curricula (see Figure 1). Examples of loose coupling could include exposing students to demonstrations of technology prior to class or lecture time to form the basis for open-ended discussion of technology. The loosely coupled end of the continuum could also include giving assignments or providing laboratory work as a supplementary or side component of a course (i.e. designed to introduce the EHR concepts to health professional students but not integrated into the main classes or lectures). One issue in loosely coupling EHR education with health professional training is that of adding additional class

or lab time to an often packed curricula in order to provide EHR education (e.g. addition of additional lab or lecture components to a curricula that are not tied or linked closely to pre-existing modules or courses).

In contrast to loose coupling, in our framework tight coupling refers to a high level of integration of the EHR into existing curricula and courses (see Figure 1). Examples of a more tightly coupled integration include requiring students to use an EHR for fundamental aspects of the health professional's training. For example this might require health informatics students to design EHR system components or assess the usability of EPRs in system design courses (forming an integral and fundamental focus of the student's overall learning experience). In medical education this might involve requiring students in a medical course to access and interact with all of their medical cases using an EHR, which would have the effect of exposing and educating these students to health information technology in a way that is deeply embedded in their regular health professional (e.g. medical training) educational activities. This approach has the advantage of making exposure to the EHR a natural part of their educational experience, just as training in the use and purpose of the stethoscope has become an integral part of medical education worldwide. However, the approach requires as a prerequisite, an appropriate assessment of where and how technology such as the EHR can be embedded into the educational curriculum (as will be described in a subsequent section of this paper).

4. THE UNIVERSITY OF VICTORIA ELECTRONIC HEALTH RECORD (EHR) EDUCATIONAL PORTAL

In order to address the educational needs described in the previous section, the authors have been involved in the development of a Web-based portal to house a variety of working EHRs. This portal, is known as the University of Victoria Electronic Health Record (EHR) Educational Portal. The EHR Educational Portal was designed to allow users (i.e. health professional students, including medical, nursing, social work, and other health professional studetns) to directly access and interact remotely with a range of representative EHR solutions over the WWW [10]. Figure 2 shows the login screen of the portal as seen by health professional students who access the Web site. The screen displays a number of EHRs that the student may access over the WWW. The student can click on a link for a particular EHR and then can proceed to log into that system remotely, to learn about its functions, access patient case data used in coursework and interact with the system to gain experience in using EHRs.

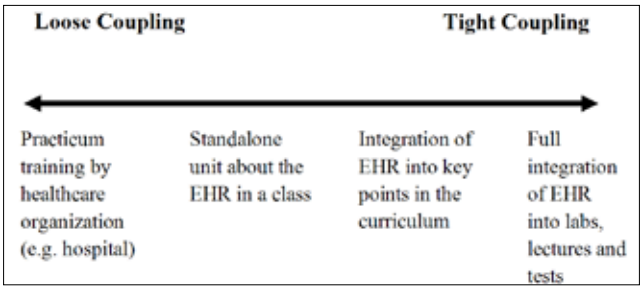

Figure 1. A continuum for considering the integration of EHRs into health professional education.

The portal currently allows for access to a variety of EMR's, EPR's and PHR's (e.g. Digital Anthrologix®, OpenVISTA, OpenMRS). Differing systems were selected for the portal in order to provide health professional educators with opportunities to teach students about a range of systems with differing design metaphors, features and functions. Exposure to these products in the classroom and the laboratory setting gives students the opportunity to learn about those aspects of system design (e.g. usability and safety) that influence clinical practice, adoption and appropriation. This gives students the opportunity to work with differing EHRs and their components prior to working in the real-world. As will be described in our discussion of its application, the portal can also be used to provide students with high fidelity simulated EHR system experiences that are representative of the real-world. This can provide opportunity to teach students how to effectively and efficiently use an EHR in the safety of the classroom and laboratory setting.

5. INTEGRATING EHRS INTO HEALTH PROFESSIONAL AND HEALTH INFORMATICS EDUCATIONAL CURRICULA

The educational framework described above has been used in conjunction with the EHR Educational Portal for a variety of projects aimed at examining potential points of EHR integration into health professional education. We have explored a number of approaches to include EHR use in nursing, medical and health informatics educational curricula. These approaches range from those that are tightly to those that are loosely coupled with health professional educational curricula. In the next section of this paper these approaches will be described across this continuum from loosely to tightly coupled.

5.1. Loose Coupling

Loose coupling in our framework refers to a weak integration of EHRs into course work and curricula. For example, training on EHRs during a student practicum experience (e.g. in a hospital) that is not integrated or linked to in-class learning would be one form of loose coupling. In such cases the health care organization (e.g. hospital or regional health authority) takes on the responsibility for providing students with education about how

the EHR works (in the same way that they train health professionals who are already practicing – the physician or nurse who is a full fledged practitioner). The student is taught how to use the EHR in a health care setting during the practicum. As another example of loose coupling, educators may teach health professionals about the EHR as a separate unit not integrated into the mainstream health professional courses (e.g. a stand alone and separate unit or lecture in a course on medical or nursing trends or technology) and this would also constitute loose coupling. This approach although useful does not offer students the opportunity to work with a record in the context of their overall health professional education. The students are likely not to have the opportunity to observe how an electronic record may affect their practice in a principled way (e.g. using an EHR to review patient lab results, respond to medications, use decision support etc.).

An approach that is less loosely coupled could involve introducing health professional students (e.g. nurses and physicians) to an EHR in a course as a supplementary activity. Here, students could be asked to explore use of an EHR to obtain information about a patient, document patient information and/or learn about the latest medications or treatments that are used in a particular patient's case. An EHR could be populated with a patient case of sufficient complexity that the students must engage in problem-solving and critical thinking in order to develop a strategy for addressing the patient's problems while at the same time learning about the features and functions of the EHR that can support their decision making involving the patient case. There are a number of advantages to using this approach including providing the students with the opportunity to learn about how to manage a specific patient's medical condition while at the same time learning how the EHR can be used to effectively support the management of the patient's condition. For example, along these lines we have introduced the EHR to nursing students in a trial run. The nursing students (over 100 students) were given passwords and access instructions for logging onto OpenVISTA remotely through our portal (described above). Students were instructed to explore the software prior to their classroom work. The students were asked to consider the technology's use in real-world settings and how the technology might support and alter their work. This was done a week prior to all the students meeting in a class to discuss the EHR and its potential as a group. Classroom activities included a formal introduction to the EHR followed by discussion and group activities where students were asked to critically evaluate the impact of the EHR upon their work. It was found that prior introduction of students to examples of working technology greatly informed subsequent discussions about the EHR and its advantages as well as issues [10,11].

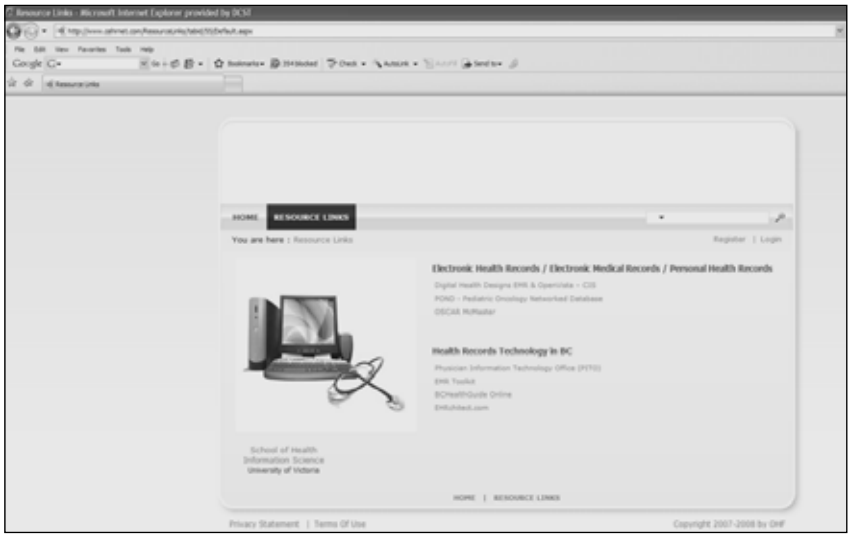

Figure 2. Web page of the EHR Educational Portal showing links to different EHRs.

5.2. Tight Coupling

Tight coupling involves a high level of integration of information technology such as the EHR into the health professional curriculum. This might involve teaching students about the EHR and integrating it into key "insertion" points in a health professional curricula, where the technology becomes a way of delivering information used in classes (e.g. patient cases), or is used as a required technology in the teaching of health professional decision making, reasoning and information seeking skills. In this case the EHR itself can be used as a teaching tool to deliver primary course content and track the quality of student learning experiences. As an example, the authors have been involved in the tight integration of an EHR into a fourth year medical program [10,11]. In this trial run, using the EHR Educational Portal (described above) all 200 fourth year medical students in the province of British Columbia were required to access and use an EHR system (i.e. Digital Anthrologix®) in order to access and work with a selected medical case that formed the core for a problem-based medical curricula. In this example, rather than using paper hand outs to present the medical case to the students, the EHR was used as the vehicle for not only accessing information, but also for entering patient data, documenting the patient case and using advanced tools and features such as electronic decision support. In our most current work along these lines we are extending the integration of the EHR to include development

of modules for testing and assessing the skills of medical students in using this emerging technology to both access and document patient information, as well as to use the technology effectively in making medical decisions.

As another example of tight coupling, the EHR Educational Portal has been used to educate health informatics students at the undergraduate and graduate level in the design, development and evaluation of EHRs and their related technologies (e.g. EPR, EMR and PHRs). At the undergraduate level, health informatics students have reviewed and used the portal systems as part of their coursework (both in labs and classes) to develop health informatics competencies. The open source systems allow for assignments where students can work on designing, programming and testing new modules and functionalities. Graduate level health informatics students are also designing, developing and evaluating EHR systems. Students now have the opportunity to see and work with differing types of EHRs in the classroom and laboratory settings. The use of representative EHRs has become an integral part of classroom training in both a course on Health Information System Design (with students developing EHR components as the major focus of the course) as well as a course on Human Aspects of Healthcare Systems (with students focusing their studies of usability of systems by critiquing and suggesting modifications to EHRs on the portal). Current application includes work by graduate health informatics students in development of on-line educational packages for use in developing countries, based around OpenMRS and related software (as a core part of research training at the graduate level).

6. DISCUSSION

Information technologies such as the electronic health record are changing healthcare. Healthcare professional students have a need to learn about and experience this technology in an effective and integrative manner that complements their health related studies and that makes exposure to this new technology seamless and natural. In addition, as future designers, developers and implementers of health information technology, it is important the health informatics students also have exposure to such systems (to critically study their design and compare and understand key aspects of their design. In this paper the authors suggest that to improve understanding of and consequently adoption of EHRs (and related technologies) there is a need for health professionals and health informatics students to be provided with the opportunity to work with several differing types of EHRs and their components (including EHRs that have differing design metaphors, features and functions). The authors have been involved in the development of a framework for considering such integration that has proven effective in a number of educational experiences described in this paper. In parallel with this effort, the authors have also developed a Web portal that provides remote access to several differing EHR's and their components over the WWW. The portal has been successfully used by several health professional educational programs (i.e. medicine, nursing and health informatics) and can be used as a vehicle for integrating the EHR into classroom, lecture and laboratory activities. The portal provides health and health informatics professionals students with opportunities to examine and review varying EHRs and their components, prior to their use of them in real healthcare settings. The portal, in conjunction with classroom and laboratory education, provides opportunities for in-classroom, laboratory and hands-on experience in using health information systems. It is concluded that in order to improve adoption of EHR and related technologies, new frameworks for guiding the integration of technology with educational strategies will be needed in order to form a basis for effective integration into curricula.

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