Implementing Electronic Health Records in Nursing Education

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Abstract

Registered Nurses (RNs) make up the largest group of healthcare workers that use electronic health records in the United States, yet many nursing schools do not have electronic health record training in their curricula. An academic electronic health record (AEHR) used within the nursing curriculum will prepare new nurses to use electronic documentation in a way that will provide safe, quality care, and enable necessary financial reimbursement. To determine the benefits and barriers to implementing an AEHR in prelicensure nursing curricula, a review of the current literature was undertaken in widely recognized databases. The findings were organized using Sittig and Singh's 8-Dimensional Model of Sociotechnical Change as a framework. Recommendations guided by the literature review include how to use an AEHR in prelicensure nursing courses found in one university's curriculum. By systematically addressing and mitigating barriers to implementing an AEHR, faculty in Bachelor of Science in Nursing (BSN) programs will be empowered to make this change to curricula. Innovative use of the AEHR throughout the curriculum can be facilitated by understanding where best to insert this content.

Key Words: nursing education, academic electronic health record, nursing curriculum, nursing students, nursing faculty

Introduction

Documentation is one of the most crucial aspects of nursing care, as reflected in the old nursing adage, "If it wasn't charted, it wasn't done" (Carroll-Johnson, 2008). Hendrich, Chow, Skierczynski, and Lu (2008) found that nurses in an acute care medical surgical unit spend approximately 147 minutes charting in a typical 10-hour shift. The electronic health record (EHR) is where this important collection of data, information, knowledge and eventually wisdom resides (Matney, Brewster, Sward, Cloyes, & Staggers, 2011). Nursing education, however, has not kept pace with the need for nursing students to learn how to use this valuable tool. Nursing students have limited access to EHRs in prelicensure programs (Baillie, Chadwick, Mann, & Brooke-Read, 2013; Pobocik, 2015).

As health information technology (HIT) becomes more prevalent in every clinical setting due to federal mandates that tie documentation to value-based financial reimbursement, nursing graduates will be expected to be more proficient in documentation and navigation within EHRs when entering the work force (Gardner & Jones, 2012). While accrediting bodies such as the American Association of Colleges of Nursing (AACN) (2008) regard information technology as a core competency, many schools of nursing rely on clinical rotations at local hospitals to fulfill this educational need (Chung & Cho, 2017). A lack of information regarding the local hospitals' attitudes regarding this role exists. Despite the mounting pressure to produce graduate nurses with these types of documentation skills, nursing programs have not kept pace with demand (Gardner & Jones, 2012). Nurse faculty and nursing students' attitudes and perception toward health information technology in nursing education have been studied, yet concrete descriptions and procedures for implementing technology are lacking (Hern, Key, Goss, & Owens, 2015; Miller et al., 2014).

The gap in technology fluency between nursing faculty and most nursing students has been noted as one reason nursing education has not embraced academic electronic health records (AEHRs) in many curriculums (Brooks & Erickson, 2012; Hern et al., 2015). The translation of nursing wisdom into an electronic format may seem difficult to nursing faculty who are not familiar with the standard language and decision support systems in many AEHRs. In addition, when nursing programs already suffer from overloaded curriculums, the inclusion of another new program may feel overwhelming (Chung & Cho, 2017; Sorensen & Campbell, 2016).

The cost of failing to implement an AEHR may result in failure to meet accreditation standards and in graduates who are less prepared to keep patients safe. Patient safety can be affected when recently graduated BSN-prepared nurses are not ready to participate fully in the use of health technology. In addition, employers must spend time and money in bringing graduate nurses up to the needed level of competency (Miller et al., 2014).

Electronic health records are poised to offer nursing, as a profession, an opportunity to describe and analyze nursing care in ways that have not been possible previously (Welton & Harper, 2016). Nurses have long struggled with clearly defining the value they bring to patients, communities, and populations. By implementing new methods to extract relevant data, nurses can more comprehensibly demonstrate how their care positively impacts patient outcomes (Welton & Harper, 2015). Nursing students should be taught concepts such as "big data," characteristics of this type of data and the impact this type of data may have on clinical decision making (Topaz & Pruinelli, 2017). In learning to use an AEHR, students will gain an understanding of the benefits of these data for nurses and patients alike. Failure to expose students to these concepts early in their education also can slow the growth of nursing informatics as a specialty (Topaz & Pruinelli, 2017).

Implementing an AEHR in a prelicensure nursing program requires planning and foresight. Just as healthcare systems are complex, interactive entities, so are schools of nursing (SONs). Monetary costs, time constraints, manpower and physical space are some of the areas to be addressed when starting a new program in a SON or a hospital. By systematically addressing the confounding factors in advance, and planning how to mitigate them, new and existing programs will likely have a better chance of surviving.

Statement of Purpose

The purpose of this review of the literature is to identify and address critical factors in AEHR implementation and use. The question guiding this review of the state of the science is: What are the barriers and benefits to implementing an AEHR in prelicensure nursing programs? The purpose of this paper is to build a case for the implementation of an AEHR throughout a prelicensure BSN curriculum to produce better prepared nurse graduates. This was accomplished by review, organization, and synthesis of existing information on the barriers and benefits of AEHR implementation in prelicensure nursing programs.

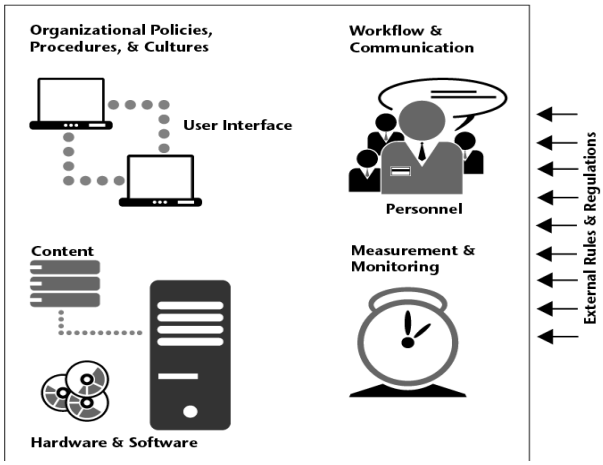
Conceptual Model

Health care has been characterized as a complex adaptive system (Rouse, 2008). A characteristic of this type of system is that it cannot be broken down into individual components, studied and put back together to understand how it works. There is no overarching authority to design the system; rather, it is composed of independent agents who may have conflicting goals and behaviors, yet have learned to adapt to each other (Booth, Sinclair, Brennan, & Strudwick, 2017a; Rouse, 2008; Sittig & Singh, 2010). When attempting to implement health information technology such as an AEHR, the complexity of the system needs to be considered, including the interaction of social and technological aspects (Booth et al., 2017a). As more healthcare

organizations utilize EHRs, nursing programs will be expected to provide experiences in working with them (Herbert & Connors, 2016). The social and technological challenges of implementing an AEHR should be investigated prior to use (Booth et al., 2017a).

Sittig and Singh's 8-Dimensional Model (2010) provides structure to examine and organize the barriers and benefits to implementing an AEHR. Each dimension relates to a specific challenge found in implementation and use of health information technology, such as AEHRs. Booth et al. (2017a) used this model to develop and implement an academic electronic medication administration record (eMAR) in a school of nursing in Canada. This model is also used outside the academic world to facilitate implementation of EHRs in commercial healthcare (Irizarry & Barton, 2013). See Figure 1.

Figure 1. 8-dimensional socio-technical model of safe and effective EHR use.



Adapted from Menon et al., 2014.

The eight dimensions are not independent, hierarchal, or sequential, but are interrelated and interdependent. These dimensions are: hardware and software; clinical content; human computer interface; people; workflow and communication; internal organization features; external rules and regulations; and measurement and monitoring (Sittig & Singh, 2010). Changes in any one of these dimensions, as described below, may lead to significant changes in another.

The hardware/software dimension is purely technological. It includes all the equipment and software used to power, support and operate clinical applications and devices. The clinical content dimension is defined as the data-information-knowledge that is stored in the system. Clinical content are data that can be entered, read, modified, or deleted using controlled vocabulary items. Human computer interface refers to how the user interacts with the system. Examples include: 1) keyboard height; 2) size of the text on the computer screen; and 3) number of clicks needed to enter an order. All the humans involved in the design, development,

implementation and use of an EHR are included. This dimension addresses the way the system makes people think and feel. Training is important, but some user errors can be traced back to poor system design. Patient-centric care requires that consumers have access to their electronic health information. This means that patients will also become users of EHR systems. Workflow and communication require collaboration. Healthcare systems require that people work together to accomplish patient care. EHRs should facilitate this communication in a timely manner. Internal organizational policies, procedures and culture influence the implementation of EHRs, what they are used for and the acceptance of technology in general. Are the policies and procedures of the organization reflected in the EHR? External rules, regulations and pressures include laws and acts that motivate EHR use, place constraints on the use of data from EHRs, and upcoming initiatives that may influence the design of EHRs. System measuring and monitoring allow for the collection of data that can be used to document the effectiveness of EHR use, as well as the availability of the system for use. How clinicians use the system can also be measured.

The literature review is framed around Sittig and Singh's 8-Dimensional Model (2010). Each of the eight dimensions will be explored with benefits and barriers discussed. To realize the benefits of AEHR, it is recommended that these dimensions should be examined in the context of specific schools of nursing's initiation preparations.

Methods

We used a literature review method to address the question: What are the barriers and benefits to implementing an AEHR in prelicensure nursing programs? The search engines CINAHL Complete, ERIC (education content), Academic Search Complete, Medline, PubMed, PsycINFO and Google Scholar were used to gather information using these search terms: nursing education, academic electronic health record, electronic medication record, nursing curriculum, nursing students, and nursing faculty. The timeframe for the search was January 2007 through August 2018. Articles were restricted to those published in English in peer-reviewed journals.

Results

Two articles were identified as relevant to this review from CINAHL Complete, and 41 articles were found in Pub Med with 12 articles selected based on title and abstract review. An additional 12 articles were reviewed using the snowball method in PubMed. Four articles were identified using PsychInfo with one article accepted for review based on title and abstract. A search using Google Scholar resulted in no new relevant articles. Twelve articles were obtained using Academic Search Complete with only one non-duplicate and relevant article reviewed. Two articles were identified using Medline and both were duplicates. In total, thirty-five articles were reviewed. Overall evidence on the use of AEHR from both student and faculty perspectives is weak. Of the 35 articles reviewed, six were opinion (n=5) or literature review papers (n=1), 7

were descriptive *"How to"* implement papers, 9 were descriptions of pilot projects from a variety of academic settings, 5 were qualitative studies, 4 used mixed methods and 4 were quantitative studies. A more detailed author search did not identify long-term follow up from the pilot projects. Of note, all studies had small sample sizes, and were convenience and cross-sectional-type investigations.

Literature Review

This AEHR literature review is framed within the context of the Eight Dimensions of Sitting and Singh's Socio-technical conceptual model. The dimensions were further organized into three categories: technical dimensions, social dimensions, and a sociotechnical blurred dimension (Booth et al., 2017a). A summary of the benefits and barriers is presented in Table 1.

Technical Dimensions

Technical aspects of AEHRs appear to have been a barrier to implementation in nursing programs for a variety of reasons. Software and hardware can be costly and quickly outdated, and creating customized software is complex. Nurse educators typically do not have the knowledge of wireless networks, computer languages or programming needed to fix technical problems they encounter. Careful attention should be given to investigating and understanding software and hardware requirements before any monetary investment is made (Gloe, 2010).

The software and hardware dimension of Sittig and Singh's model is defined as the physical devices and software required to keep the applications running. Computers, monitors, printers, keyboards, mouse devices, or other data entry devices as well as the centralized (attached to the network) data storage devices are included. Equally important, but not as easily recognized, is the infrastructure required to keep computers functioning, such as high capacity air-conditioning and batteries that provide uninterrupted power in the event of an electrical failure. These parts can easily be taken for granted until one of them fails. Kilbridge (2003) described a computer crash that disabled a Boston hospital for 4 days in 2002. The crash was attributed to running old, out of date computer equipment with an outdated software program designed to handle lesser complex networks. Other barriers to effective EHR use are computers that run too slowly to efficiently document patient care (Palumbo, Sandoval, Hart, & Drill, 2016). The planning process for implementing an AEHR should include a review of the hardware and software available, the network capacity that will support it, and how it will be set up and maintained.

One reason given for not using an AEHR in nursing programs has been the large variety of EHRs available (Gardner & Jones, 2012; Jansen, 2014; Baxter & Andrew, 2018; Gonen, Sharon, & Lev-Ari, 2016). Nursing faculty are overwhelmed by the many types of EHRs in use in clinical sites and felt that it was impossible to teach students how to use each one (Gardner & Jones, 2012). However, this argument pales when it is noted that most students have familiarity

with different types of word processing software, internet browsers and computer operating systems. It is more important to learn the basic principles of entering, managing, and using data entered in an EHR, than to learn a specific program (Gardner & Jones, 2012; Gonen et al., 2016; Meyer, Sternberger, & Toscos, 2011).

Choi, Park, and Lee (2016) identified three ways in which an EHR can be obtained for use in an academic setting: develop in-house software, purchase premade software or access to a Web-based site from a vendor, or collaborate with community stakeholders and share their access to commercial software. Cloud-based options for AEHR programs are also available (Kushniruk, Kuo, Parapini, & Borycki, 2014). Choosing software can be a daunting barrier when considering implementation of an AEHR. Gloe (2010) described the process by which AEHR selection was completed by one school of nursing concluding that a thorough description of the costs, functionality, and support offered by each vendor should be tabulated and compared.

System monitoring and measurement is another important aspect of the Technical domain**.** As AEHRs are implemented and used, data can be gathered electronically regarding their use (Wynn, 2016). Measurements can include the amount of time the system is up and running correctly, how the system is being used by faculty and students (Schaar & Mustata Wilson, 2015), the effectiveness of the user in meeting certain parameters, such as vital sign charting accuracy in simulation (Mountain, Redd, O'Leary-Kelly, & Giles, 2015; Bowling, 2016), and any unintended consequences of using the system.

Social Dimensions

Social dimensions are those that involve human factors. These aspects are not dependent on a physical tool, such as a computer or piece of software alone. Instead, these dimensions determine how the physical tools are used.

External rules and regulations constitute an important component of the social dimension. Initial implementation of EHRs in healthcare settings was driven by external factors such as the Health Information Technology for Economic and Clinical Health (HITECH) Act (American Recovery & Reinvestment Act, 2009) and ensuing governmental incentives and fines. Hospitals and clinics responded to these drivers by purchasing or producing EHRs that met the basic requirements outlined by the laws enacted. Similarly, external regulators such as accrediting bodies for schools of nursing have recognized the need to prepare future users of EHRs by defining nursing curriculum essentials and competencies regarding health information technology.

The Quality and Safety Education in Nursing (QSEN) Institute, using competencies defined by the Institute of Medicine (IOM) (Health Professions Education: A Bridge to Quality, 2003), developed a set of knowledge, skills, and attitudes that prelicensure nursing students

should be taught (Cronenwett et al., 2007). These sets were grouped into six competencies that together define what all registered nurses should be able to do upon graduation. The sixth and final competency is informatics. Informatics can be defined as the ability to "use information and technology to communicate, manage knowledge, mitigate error, and support decision making." (Cronenwett et al., 2007 p. 129). Some of the specific skills for this competency identified by Cronenwett et al. include the navigation of EHRs along with documenting and planning cares in an EHR.

One of the most widely known accrediting bodies for nursing schools, the American Association of Colleges of Nursing (AACN) also supports the inclusion of health information technology such as EHRs in nursing curricula to ensure that graduates of BSN programs have competencies in patient care technologies and information management systems. These external agencies influence what is considered a professional nursing program. In order to maintain or achieve national accreditation, nursing school faculty will be asked to show how their programs are meeting these requirements. AEHR utilization as part of a nursing curriculum, solidly grounded in the relevant QSEN competencies and AACN accreditation requirements related to nursing informatics would offer students the experience needed to gain competency.

The need to teach EHR use has been recognized by national nursing organizations; however, national standards for what comprises adequate nurse informatics training is lacking (Cummings, Shin, Mather, & Hovenga, 2016). Hebda and Calderone (2010) addressed this missing linkage by connecting the informatics competencies recommended by the Technology Informatics Guiding Education Reform (TIGER) education and faculty plan (Gugerty & Delaney, 2009), to the AACN and QSEN health information competencies. However, evidence of the use of these competencies throughout nursing curricula is lacking in the literature.

Another example of external rules and regulations impacting the use of AEHR comes in the lack of student access to EHRs in some clinical sites (Choi, Park & Lee, 2016). If students are not allowed access to EHRs at clinical sites, due to patient data security concerns (Schumacher, 2010; Jones & Donelle, 2011) or lack of staff availability to assist students in verifying the data they are entering, schools of nursing will need to address the lack of opportunity by providing AEHR education in the nursing curriculum (Baillie et al., 2013; Brooks & Erickson, 2012; Greenawalt, 2014; Choi, Lee & Park, 2018). Sittig and Singh (2010) describe this dimension of the model as "purely on the social end of the socio-technical spectrum" (p.5). People are defined in this dimension as those who use the system such as clinicians and patients, as well as those who create the system such as software developers and system configuration personnel.

In the process of AEHR implementation in undergraduate nursing curriculum, nursing faculty have been implicated as a barrier. Knowledge, skills, and attitudes of nursing educators play a role in the acceptance and success of AEHRs (Gassert & Sward, 2007; Flood Gasiewicz &

Delpier, 2010; Garner & Jones, 2012;Villaran & Matcharadze, 2014; Chung & Cho, 2017; Baxter & Andrew, 2018. Bani-issa and Rempusheski (2014) found a constructivist teaching belief was most helpful when embracing technological changes in nursing curricula. Central to this teaching belief is that students come with a base of knowledge and will build on what they already know. This means recognizing current students "come from the computer generation and (are) more comfortable with computers" (p. 908).

Chung and Cho (2017) found that most nursing faculty were self-taught in the use of EHRs for nursing documentation and felt unsure about the use of AEHRs due to the lack of knowledge on how to use them. Resistance to using AEHRs was also due to the belief that paper charting is the same as computer charting, and that EHR training should be done for job purposes, not for education (Chung & Cho, 2017). In addition, Myer, Sternberger and Toscos (2011) and Sorenson and Campbell (2016) noted that the lack of time to learn a new system, and the addition of more information to already full curricula were also cited by nurse educators as barriers to implementing AEHRs. Some instructors believe that the time spent learning documentation skills may be better used to discuss patient care (Wynn, 2016). Another barrier for nurse educators was the variation in EHRs used in clinical sites, which made it impossible to teach the specific use of every kind (Gardner & Jones, 2012; Baxter & Andrews, 2016). Many studies have found that educating faculty in health information technology (HIT) is crucial to successful implementation of AEHRs (Hern et al., 2015; DeBlieck & Mullins, 2016; Bowling, 2016).

The benefits to nursing faculty of implementing an AEHR are found in the type of learning that takes place when students interact with this technology. Bani-issa & Rempusheski (2014) found that students using an AEHR were constructing their own knowledge by learning from clinical cases, learning by analyzing clinical problems, and learning in a collaborative manner. Using an AEHR helps "create a technology rich learning environment for students, exposing them to evidence-based practice, standardized nursing language, and informatics competencies" (Gardner & Jones, 2012, p.3).

Although many students are comfortable with the use of technology in their personal lives, it cannot be assumed that all will have the same degree of knowledge and comfort using EHRs (Skiba, Connors, & Jeffries, 2008). Assessing student computer skills and gaps in knowledge can overcome the barrier of student hesitancy to use an AEHR (Gonen, Sharon, Offir, & Lev-Ari, 2014; Watts, 2016). Students increase in their confidence and proficiency in AEHR use through more opportunities to chart in them (Lucas, 2010; Mahon, Nickitas & Nokes, 2010; Jansen, 2014; Vana & Silva, 2014; Titzer, Swenty, 2014; Warboys, Mok, & Frith, 2014; Kowitlawakul, Chan, Pulcini & Wang, 2015; Titzer, Swenty & Mustata Wilson, 2015; Bowling, 2016; Wynn, 2016; Choi, Lee & Park, 2018). Because students are exposed to many types of word processing programs and computer operating systems through their personal and pre-

nursing school education, they are prepared to think of an AEHR as another new system to learn that has similarities to others they have used (Meyer et al., 2011).

Another benefit for nursing students to learn more fully the use of EHRs is their increased familiarity with HIT. This would position the students to assist their patients and clients in navigating their own online health information. Consumers are being given greater access to their own health information through patient portals. Nurses will be needed to assist consumers with understanding the data that are available to them, as well as how to use that data to improve their health status (Ball, Smith, & Bakalar, 2007; Barton, 2014).

Several points deserve mention in regard to Internal Organization Features**.** External rules and regulations often play a part in the creation of internal organization standards and expectations (Sittig & Singh, 2010). In the context of implementing an AEHR in a school of nursing, the requirements for accreditation are often driving factors in adding this educational tool. The culture of an organization will determine how the change is accepted and implemented. Program administrators are key to advocating for the resources necessary to carry out successful integration of an AEHR. By establishing a strategic plan and designating the essential roles—such as faculty champions and task force leaders, administrators give direction and support to this undertaking (Herbert & Connor, 2016; Titzer, Swenty, & Mustata Wilson, 2015; Griffen-Sobel et al., 2010).

Herbert and Connor (2016) found in a survey of nursing schools that were working to implement AEHRs throughout their programs that the most important success strategy was to assign an AEHR champion within the program. They defined an AEHR champion as someone who facilitates the faculty adoption and diffusion of the AEHR throughout the program (Herbert & Connors, 2016). Johnson and Bushey, (2011) also noted the role of a "super user" was crucial in the success of an AEHR. Super user is defined by McNeive (2009, p.136) as "clinicians who link the information technology (IT) world with the patient care world..." As hospitals, clinics and skilled nursing facilities make the change from paper to electronic charting, or upgrade their existing systems, having a nurse that is well versed in the new program is better accepted as a teacher by the other nurses. The super users' ability to empathize with the change processes of technology creates a bond that encourages better learning (McNeive). In the arena of nursing education, this would be a faculty member who is currently using the AEHR as an innovative teaching tool (Johnson & Bushey, 2011). Characteristics of a super user include a willingness to embrace the new technology, be a patient teacher, and have a vision of how the new technology can benefit nurses in their everyday work. Super users can also function as a liaison between IT and the end users of the technology (McNeive). Lack of key person(s) can constitute a barrier to AEHR implementation.

As nursing curriculum is reviewed and revised by schools, opportunity to make internal organization changes are presented. A survey of 222 novice/ new graduate nurses and 326 nurse

mangers identified gaps in 13 of 28 informatics skills and knowledge areas felt to be critical to effective EHR use (Miller et al., 2014). Nurse educators and clinical sites are just learning what skills students need. As technology advances, there is a need to have dialogue between nursing schools and facilities used for clinical education to address and identify gaps, with the possibility of partnerships (Abrahamson et al., 2015; Miller et al., 2014).

Most nursing programs depend on clinical care settings to help educate their students through clinical rotations, shadowing experiences and practicum hours. This reliance on clinical sites for teaching of documentation in an EHR leads to discrepancies in student education. Some facilities provide structured, expert-led training while others may provide no training at all (George, Drahnak, Schroeder, & Katrancha, 2016). The internal organization of a nursing program needs to be willing to "bring the outside in" (Titzer & Swenty, 2014, p. 212).

Integrating HIT and an AEHR as curriculum is revised, is a logical step (Brooks & Erikson, 2012). AEHR use can be implemented beginning with entry-level courses followed by increasing complexity of use throughout the program (Gardner & Jones, 2012; Johnson & Bushey, 2011). The degree to which informatics are woven throughout a nursing program can be a barrier or benefit to the use of AEHR.

Another important component of the Social Dimension pertains to *Workflow and Communication.* Implementing an AEHR would require a change in the process of teaching documentation and synthesizing of data from a patients' chart. Booth, Sinclair, Brennan and Strudwick (2017a) found that implementing an academic electronic medication administration record caused sweeping changes in teaching the workflow of this skill. Understandably, nurse faculty may feel hesitant to commit to a new technology or software due to other demands of teaching and research. Careful planning and slow roll-out of curricular AEHR integration could help mitigate this barrier (Hern et al., 2015). Of note is that EHR use in the clinical setting is touted to promote better workflow (Brooks & Erickson, 2012).

Effective communication while using technology is a relatively new area of study in health care. Communication with other members of the health care team, as well as communication with patients is impacted by use of HIT. A 2014 survey of nearly 14,000 registered nurses by Black Book Market Research showed that 94% of RNs felt that the EHR currently used in their facility had not improved communication between nurses and the rest of the health care team (Nelson, 2016). As bedside EHR use has increased, so has the need for nurses to learn to be present with the patient, not just looking at the screen (Palumbo et al., 2016). New nurses were noted to have weakness in the crucial communication areas of lab results retrieval, diagnostic results retrieval, discharge planning documentation, care plan development and patient education documentation (Miller et al., 2014). Nursing education could help to mitigate these problems by teaching and learning strategies that address communication within an AEHR to other members of the health care team.

Patient safety is another critical reason to teach effective communication. Because patient treatment is often based on nursing documentation, early exposure to EHR use in the curriculum promotes patient safety (Taylor, Hudson, Vazzano, Nauman & Neal, 2010; Bowers et al., 2011; Jansen, 2014; Vana & Silva, 2014; Bowling, 2016; Sorenson & Campbell, 2016; Choi, Park & Lee, 2016). By allowing nursing students to practice documenting in an EHR at the beginning of their schooling, there is time for faculty to intervene and assist in gaining proficiency if needed. Bowling (2016) also found that students' electronic charting was quicker and more accurate when done more frequently. If inaccuracies occur in documentation, patients may experience adverse outcomes. Patient safety is affected by inadequate EHR education (Mountain et al., 2015). Early and frequent exposure to HIT in nursing education can increase student confidence, accuracy and proficiency in charting electronically (Chung & Cho, 2017; Gonen et al., 2014; Mountain et al., 2015).

The opportunity to teach communication between health care team members is another benefit of implementing an AEHR. Creating assignments that build on other disciplines contributions to a fictional patient chart is one method of interprofessional education (Titzer, Swenty, & Mustata Wilson, 2015). Simulation activities that include multiple disciplines and allow them to access their respective charting areas were found to be beneficial for students (Schaar & Mustata Wilson).

Clinical content. A key clinical component of acute care practice is communication between providers and patients. A benefit of implementing an AEHR found within this social dimension is the exposure of nursing students to the standardized language of nursing and healthcare. Prior to the wide-spread use of HIT, nursing language varied by specialty, region, and individual . By making the language used to describe medical conditions, nursing care plans and assessments consistent throughout HIT, knowledge can be more easily shared across disciplines (Duffy, 2015; Greenawalt, 2014; Pobocik, 2015). The North American Nursing Diagnosis Association now known as NANDA- International (NANDA-I) is responsible for developing standardized definitions for use in selecting and evaluating nursing diagnoses, interventions, and outcomes. Nursing Interventions Classifications (NIC) and Nursing Outcomes Classification (NOC) systems are recognized by the American Nurses' Association (American Nurses Association, 2011). This standard nomenclature improves patient safety (Rutherford, 2008).

Charting by exception is another skill more easily taught by the examples found in an AEHR (Duffy, 2015). Charting by exception also standardizes documentation by listing what the normal expectations for a body system are, only recording deviations from those norms (Smith, 2002). Nursing students can use the data gathered in the AEHR to identify nursing diagnosis and create nursing care plans (Pobocik, 2014). Using clinical data in the nursing process to build the patient's story is one of the key functions of documentation. Students need to learn how to

connect the small units of data into the wider picture of the whole patient (Kennedy, Pallikkathayil, & Warren, 2009; Milano, Hardman, Plesiu, Rdesinski, & Biagioli, 2014).

A barrier found within this dimension can be in the lack of functionality some AEHRs exhibit (Kowitlawakul, Wang & Chan, 2013). Nursing faculty may prefer to enter in their own data, such as vital signs, lab values, and imaging studies into the case studies or assignments within the AEHR. Some programs allow this flexibility, but not all. A careful consideration of how the software or web-based program works and how faculty want to use it is necessary prior to committing time and money resources (Hern et al., 2015; Gloe, 2010). Booth et al. (2017a) overcame this barrier by creating their own eMAR for use in simulation and throughout the curriculum.

Sociotechnical Blurred Dimension

The Sociotechnical dimension is unique in that it describes the interaction of people with technology. Technology affects people, who in turn affect technology. For example, a software program may be described as "difficult to use" or not "intuitive". It may be as simple as moving a button on the screen or decreasing the steps required to complete a task that will change the way the users accept the program. This dimension contains one subset, as described in the next section.

The Human-Computer Interface subset of the sociotechnical dimension is defined here as "the interface that enables unrelated entities to interact within the system… and includes aspects of the system that users can see, touch or hear" (Sittig & Singh, 2010, p.5). It also includes the ergonomic aspects of the interface. Barriers to implementing an AEHR in this dimension can be found in the type of equipment available to a school of nursing, as well as the resources needed to acquire equipment. The physical facilities of a school of nursing may make AEHR use difficult. For example, if a computer for charting during simulation is not located near the patient, students may have difficulty in documenting (Booth, Sinclair, Strudwick, et al., 2017b). The design of the software, its functionality and ease of use impact how users engage with the system (Kowitlawakul et al., 2015).

Human-computer interface should also include the attitudes with which users approach this technology. Nursing students may feel threatened or challenged by using computers due to their prior experiences (Gonen et al., 2014; Watts, 2016). It is not safe to assume that all students are comfortable with computer use due to their generational exposure to technology (Hebda & Calderone, 2010). It is undeniable that the use of computers, especially at the bedside and in the exam room, have impacted patient/ nurse interactions. The patient may feel the nurse is spending more time looking at the screen, more time typing than talking and making less eye contact when using an EHR (Palumbo et al., 2016). Nursing students need the opportunity to learn appropriate ways to interface with the computer and the patient.

AEHRs are not just a replacement for paper charting. They are a way to transform practice through evidence. Benefits of having an AEHR in nursing curriculum are that students are taught to use this technology to look up evidence at the bedside, to use critical thinking and not just blindly follow what the computer tells them to do, and to increase patient safety through the use of clinical decision support tools (Kowitlawakul, Wang & Chan, 2013; Chung & Cho, 2017; Furlong, 2016).

Multiple studies have found that nurse educator attitudes play a large role in the success or failure of implementing an AEHR (Bani-issa & Rempusheski, 2014; Chung & Cho, 2017; Gardner & Jones, 2012; Hern et al., 2015). Lack of knowing how an AEHR works, lack of teaching strategies on how to use this technology, and lack of time to learn technology were the most common reasons nurse educators gave for resisting implementation of AEHRs. By helping nurse educators become more comfortable with this human-computer interface through faculty development and education, this barrier can be lessened (DeBlieck & Mullins, 2016; Hern et al., 2015).

Table 1. Benefits and Barriers to AEHR

Benefits	Barriers
Measure students' accuracy and timeliness of documentation more easily. *Johnson & Bushey, 2011;George et al., 2016*	Complexity of hardware and software used in AEHRs. *Meyer et al., 2011* Internet connectivity. *Herbert & Connors, 2016; Baxter & Andrew, 2018*
Meet QSEN competencies and AACN essentials more fully (all students have same experience). *Johnson & Bushey, 2011; Bowers et al., 2011*	Multiple EHRs used in clinical sites; complexity of teaching how to use different systems. *Gardner & Jones, 2012; Baxter & Andrew, 2018* Inability to chart in EHR at clinical sites. *Choi, Park, & Lee, 2016*
Student learning when interacting with technology-collaborative, constructive, exposed to EBP, standardized nursing language, informatics competencies. *Lucas, 2010; Johnson & Bushey, 2011;Gardner & Jones, 2012; Bowling, 2016; Sorenson & Campbell, 2016*	Knowledge, skills and attitudes of nursing faculty toward AEHRs, less comfort using EHRs. *Gassert & Sward, 2007; Flood et al., 2010; Taylor et al., 2010; Garner & Jones, 2012; Villaran & Matcharadze, 2014; Chung & Cho, 2017; Baxter & Andrew, 2018*
Prepare new nurses to use workplace EHR. *Bowers et al., 2011; Brooks & Erickson, 2012; Bowling, 2016*	Lack of time and support for faculty to learn to use AEHR in courses. *Ornes & Gassert, 2007; Schumacher, 2010; Herbert & Connors, 2016; Chung & Cho, 2017; Baxter & Andrew, 2018*

Opportunity to teach how to communicate with other team member in EHR. *Bani-issa & Rempusheski, 2014*	Belief that nursing curriculum already full, no room to add AEHR. *Chung & Cho, 2017*
Increase patient safety by learning to chart accurately. *Taylor, et al., 2010; Bowers et al., 2011; Vana & Silva, 2014;Bowling, 2016; Sorenson & Campbell, 2016; Choi, Park & Lee, 2016*	Gaps in student computer skills. *Jones & Donelle, 2011; Herbert & Connors, 2016; Choi, Park & Lee, 2016*
Students develop assessment skills & connect application of documentation to EHR (Critical thinking application). *Warboys, Mok, & Frith, 2014; Bowling, 2016; Choi, Lee & Park, 2018*	AEHR usability- need to be able to use as faculty wants ie. use own case studies in AEHR charting. *Mahon, Nickitas & Nokes, 2010*
Increased student confidence in EHR utilization. *Lucas, 2010; Mahon, Nickitas & Nokes, 2010; Vana & Silva, 2014; Titzer & Swenty, 2014; Warboys, Mok, & Frith, 2014; Kowitlawakul et al., 2015; Titzer, Swenty & Wilson, 2015;Bowling, 2016; Wynn, 2016*	Limited funding & costs. *Gloe, 2010; Gardner & Jones, 2012; Herbert & Connors, 2016*
	Concerns about confidentiality. *Schumacher, 2010; Jones & Donelle, 2011*

Significance

To keep pace with the sweeping changes in healthcare brought about by the increasing use of technology, nursing education must "radically transform" (Benner, Sutphen, Leonard, Day, & Shulman, 2009, p.4). Technology in the form of smart phones, lap-top computers, and online education has changed the way we interact as a society and as healthcare providers. Terms not previously used in healthcare such as "big data", "meaningful use" and "value-based payments" are becoming more common when discussing the future uses of electronic health records and the information they contain. New nurse graduates are being asked to use technology in clinical workplaces more than at any time in the past. Nursing education must embrace these technologies, especially the electronic health record.

Nursing documentation has always been a key component of nursing education and practice. Today this documentation is done primarily within an EHR. The evidence suggests that an EHR can be much more than just a digital replacement for paper charting (Furlong, 2016). Consistent EHR use will build a patient's medical history over a lifetime and be available to many providers. The collected data from large numbers of EHRs can be used to populate knowledge banks which can then be used to inform evidence-based practice (Ross, Wei & Ohno-

Machado, 2014). An AEHR allows the students to begin to understand the depth and breadth of their role in charting. They are helping to build knowledge and eventually wisdom (Sorensen & Campbell, 2016). The human-computer interface promotes this action.

Patient safety is enhanced when students have access to an AEHR (Bowling, 2016). Documentation accuracy and application of correct nursing diagnosis were measured and found improved by Pobocik (2015) when students practiced with an AHER prior to clinical activities. Students need opportunity to become familiar with clinical decision-making tools that are embedded in EHRs to improve patient safety. Standardized nursing language is another safety feature of EHRs that students could learn through an AEHR. Clinical content, workflow and communication can be explicated and taught through AEHR use.

External factors include governmental mandates of EHR use and meaningful use incentives, while the literature shows that internal organization policies and culture, such as maintaining accreditation status, pushes nursing education to adopt AEHRs (American Association of Colleges of Nursing, 2008). The production of graduates who can document to the standard required for the workplace and who have a basic nursing informatics understanding is an undeniable expectation of external organizations and internal nursing school culture (George et al., 2016).

The evidence suggests that nurse educators need to take a more active role in learning this technology and the methods by which to teach it to students. Impediments to taking this step include limited time, limited resources, and lack of motivation (Chung & Cho, 2017; Herbert & Connors, 2016). As nurse educators examine their own knowledge, skills, and attitudes in health information technology, ways to overcome these barriers can be found. Administrative support can also help lessen these barriers.

Nurses are late comers to the design of EHR systems. To produce nurses who can create and improve EHR systems should be a long-term goal of nursing education. As the largest group of EHR users, nurses have a personal stake in the functionality of these documents. A basic understanding of nurse informatics obtained by the completion of an undergraduate nursing degree will provide the graduates with a springboard for further nurse informatics education. Software and hardware created by nurses for nurses are valuable contributions to AEHR learning. Recognizing the barriers and benefits of implementing an AEHR is the first step to making this technology a part of nursing education in general and to a specific nursing school curriculum.

Implications

Implementing an AEHR in a prelicensure nursing program is a step toward the radical transformation of nursing education. However, nursing programs already struggle to determine the most essential material to include in exponentially growing curricula (Griffin-Sobel et al.,

2010). To make a significant change such as adding an AHER to a nursing curriculum, a measured, thoughtful approach must be taken. This includes investigating how current curriculum concepts and program outcomes address the need for documentation and information technology learning and identifying ways the AEHR could be used to meet those needs.

By threading AEHR use throughout the curriculum, the students can be introduced to the technology, reinforce use of the technology, and develop a greater mastery of the technology. The National League for Nursing (2017) developed curricular thread suggestions from informatics competencies they reviewed. These are:

• use of health information technology to augment/support the nursing care process (including concepts such as safety, care improvement, decision assistance/support, outcome analysis, and data analysis);

• communication – (includes electronic health records, personal health records, standardized languages, and terminology);

• issues – (includes legal, ethical, social, security, advocacy, and public policy); and

• nursing involvement through teamwork/collaboration (covering the nurse's role in determining usability, workflow analysis, and systems selection/evaluation (NLN, 2017).

Recommendations for Practice

Implementing an AEHR in a prelicensure nursing curriculum is the recommendation of this author. Before the change in curriculum can occur, the desire to change needs to be instilled in the owners of the curriculum and the process of change needs to be outlined. Kotter and Cohen's (2002) change theory and the process of choosing an AEHR created by Gloe (2010) can be combined to enhance motivation to change and show the way to change (See Table 2).

Table 2. Integration of Kotter's Steps to Change and Gloe's Implementation Steps

Outline:	**Implementation:**
Kotter& Cohen's (2002) Eight Steps to Successful Change	*Gloe's (2010) steps to selecting an academic electronic health record*
Create a sense of urgency Pull together a guiding team	The author experienced this process during the creation of a new simulation lab Choose a committee to review options

Create a vision Communicate the vision Empower others to act Plan and create short-term wins	Identify key criteria the AEHR must have Identify potential vendors Develop questions to ask vendors Compare vendors and analyze costs The author created short term wins by outlining a week by week schedule for doing the above tasks
Don't let up Make change stick	Submit a product for approval

Timing can be helpful for creating a sense of urgency. To create a sense of urgency, the move to an AEHR could be a part of the curricular evolution that often takes place prior to accreditation or re-accreditation (National League of Nursing, 2017). A guiding group for the change is necessary in both theory and implementation, as well as a vision for what the change should entail. For faculty to embrace the change, they need to understand the vision and feel part of the decision to change. Gloe (2010) creates short term wins by outlining a week by week schedule for choosing an AEHR. As the technology is adopted and used, the guiding team or AEHR super users can continue to help faculty increase their knowledge and proficiency in using the product. This continued support will likely help the change take hold.

AEHR implementation can be better understood by examining one university's current education about documentation practice as an exemplar and making specific change suggestions. Without a structured plan to incorporate AEHR, nursing documentation as a core skill may become fragmented or subjected to academic curricula drift. In the first semester of core nursing classes, health assessment seminar assignments were written on paper. At most of the skilled nursing facility clinical sites, paper documentation or a combination of paper flowsheets and electronic medication administration records were used. Though students do simulations from the start of their nursing education, charting in simulation is minimal, and on paper. Students are taught many basic nursing skills in the practice lab in this important first semester, but no documentation regarding these skills is taught in the lab.

As the students' progress to the next semester, their documentation exposure happens primarily at the acute care hospital clinical sites, which use EHRs exclusively. Students are offered a basic hour-long training session at the college on how to use the hospital-specific EHR. There is some inconsistency in student training due to variations in individual clinical faculty knowledge of EHR and access to equipment (i.e. some instructors can take their students to the hospital computer lab and review the EHR in more depth before students start to use EHRs in clinical settings). Students participate in simulation in the second semester, but charting is again minimal, and on paper. Students continue to build their nursing skills in the practice lab but have

no documentation practice or requirement for these skills. In the third semester, with a pediatric and obstetrics focus, student exposure to electronic documentation varies greatly. Some clinical sites use an EHR, while others are community-based and have a different documentation focus. Simulation is done, with minor paper charting. Students spend less time in the practice lab learning new skills but could be practicing what they learned previously.

The fourth and final semester varies in documentation methods due to the community focus of the courses; however, in the last 3.5 weeks of the semester are spent in primarily acute care areas that include EHRs as students complete their practicum. Simulation includes robust scenarios, but charting is minimal, and on paper. Practice lab time is spent honing previously learned skills in preparation for practicum and simulation.

To facilitate effective learning, a scaffolding approach is recommended (Billings & Halstead, 2016, Chapter 13). For example, an AEHR introduced in the health assessment course would pave the way for its use in simulation and in the practice lab. As students learn to assess body systems, the documentation of that system can be done while explaining the standardized language used to express findings. While students learn skills, they can simultaneously practice charting appropriately regarding those procedures. Using this approach, by the time students participate in simulations to prepare for their final practicum, they will be familiar with the AEHR for charting in this more stressful situation, and valuable sim time will not be used learning the AEHR basics. The following section details recommendations, tailored for a specific college of nursing's curriculum, on how AEHR could be introduced in ever increasing layers of complexity.

Although students may not have the opportunity in their first semester clinical sites to use an EHR, some AEHRs allow students to create private patient charts ("Tips for Using Lippincott DocuCare in Your Nursing Program," n.d.). This would allow them to document electronically what they saw and did that day in a private space for practice. Many skilled nursing sites do not allow students to chart at all, paper or electronic, so an AEHR would be a valuable learning tool for this semester.

In the second semester, students would continue to use the AEHR to document more complex patient procedures learned in the practice lab. AEHRs can be used in theory classes as well as clinical based courses ("Tips for Using Lippincott DocuCare in Your Nursing Program," n.d.). Instructors who use concept-based teaching or "flipped" classrooms can assign patient records in an AEHR as part of the case study info given students before class. These case studies could evolve to form the foundations of patient simulations. Students are also learning legal, ethical and safety considerations for EHR use as they spend time documenting. The heavier emphasis on EHR use at the clinical sites in this second semester will not be as stressful to students if they have had AEHR exposure previously (George et al., 2016). Greater experience with AEHRs can build student confidence at the clinical site and save clinical time by not having

to focus on the basics of electronic charting (George et al., 2016). Another consideration of AEHR use is the opportunity it affords instructors to review student work. Charting accuracy and the time it takes students to document can be seen, and feedback given to improve student performance (Bowling, 2016; Mountain et al., 2015). Student proficiency with documentation eventually impacts patient safety as students graduate and enter the workforce.

AEHR in the third and fourth semesters could feature case study/patient charts in special populations, such as pediatrics and mental health. As students prepare for simulation with these types of patients, the AEHR could aid in specialized assessments and tools. A feature of some AEHRs is the ability to access evidence based guidelines and information directly from the patient's chart ("Tips for Using Lippincott DocuCare in Your Nursing Program," n.d.). This mimics a real EHR and is a first step toward producing working nurses who value and know how to find this type of information. These recommendations represent a change in thinking in the way nursing faculty approach teaching documentation. Charting can be much more than recording observations when using an EHR. For such a change to happen, at least some of the faculty must be motivated to embrace a new technology.

Conclusion

Documentation is an integral part of nursing care. Electronic health records have changed the import and significance that this basic nursing activity carries. Patient safety is ultimately affected by the ability of the nurse to document accurately and fluently in an EHR. Innovative use of the AEHR throughout the curriculum can be facilitated by understanding where and how to make changes. As nursing faculty plan curriculum, it is recommended that these changes be integrated at all levels of the baccalaureate nursing educational experience. Use of a change theory to guide implementation, such as Kotter's Eight Step Change Model, can make the transition to this new type of nursing documentation education part of a well-designed and logical addition to the foundational skills required of today's nursing students. While many dimensions need to be considered in adding this type of learning to nursing education, the benefits of doing so will likely ensure that this education produces nursing graduates who can contribute to and record accurately their part in positive patient outcomes. By systematically addressing the barriers and highlighting the benefits of implementing an AEHR, faculty at schools of nursing will be empowered to successfully make this change to curricula.

Foundational to the majority of undergraduate nursing programs are the clinical instructors. Many of the clinical instructors may also be teaching assistants (TA's) as a means for advancing their education through the master's or other graduate program level. Thus, they serve in both faculty and student roles. Graduate nursing students who meet these criteria may also work part-time to fulfill clinical practice requirements or employment requirements for income.

These clinical instructors may be champions for AEHR as well as role-models for UG nursing students in the use of AEHR as well as safe and accurate patient documentation and assessment.

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