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The Informatics Nurse Specialist Role in Electronic Health Record Usability Evaluation

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THE INFORMATICS NURSE SPECIALIST ROLE IN ELECTRONIC HEALTH RECORD USABILITY EVALUATION

Health information technology (IT) is changing the way health information is documented, stored, viewed, retrieved, shared, managed, and consumed.¹ Some of these technologies include electronic health records (EHRs), personal health records, electronic medication prescribing, personal health tools (eg, mobile applications), and online communities. Recent legislation in the realm of health IT has also had a major impact on the field. The Health Information Technology for Economic and Clinical Health (HITECH) Act under the American Recovery and Reinvestment Act of 2009 was initiated to improve the coordination and delivery of American healthcare through health IT, including the adoption and meaningful use of EHR systems.¹ This nudge toward health IT for providers initiated by healthcare reform has the ability to increase EHR adoption rates in the United States. Currently, the Office of the National Coordinator reports that hospital EHR adoption rates have more than tripled from 12% in 2009 to 44% in 2012.¹ The combination of rapidly evolving health IT, complementary legislation, and expanded EHR adoption is pushing clinician interaction with technology to the forefront of practice.

Increased implementation of EHR systems has a considerable impact on nursing. Nurses comprise the largest group of healthcare providers employed in all healthcare delivery settings and are therefore the major group of EHR users. This is due to their wide geographic avail-

Health information technology is revolutionizing the way we interact with health-related data. One example of this can be seen in the rising adoption rates of electronic health records by healthcare providers. Nursing plays a vital role in electronic health record adoption, not only because of their numbers but also their intimate understanding of workflow. The success of an electronic health record also relies on how usable the software is for clinicians, and a thorough usability evaluation is needed before implementing a system within an organization. Not all nurses have the knowledge and skills to perform extensive usability testing; therefore, the informatics nurse specialist plays a critical role in the process. This article will discuss core usability principles, provide a framework for applying these concepts, and explore the role of the informatics nurse specialist in electronic health record evaluation. Health information technology is fundamentally changing the clinical practice environment, and many nurses are seeking leadership positions in the field of informatics. As technology and software become more sophisticated, usability principles must be used under the guidance of the informatics nurse specialist to provide a relevant, robust, and well-designed electronic health record to address the needs of the busy clinician.

KEY WORDS

Electronic health records • Implementation •
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ability, nimble skill set, and cost to employ relative to physicians.² An assortment of health IT impacts are expected to cause profound changes for nurses in (1) the content and process of clinical practice, (2) roles and

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workforce skill mix redesign, (3) new paradigms for care delivery time and place, and (4) increased efficiency with better outcomes.² This means that technology is being incorporated into everyday nursing practice in a way not yet seen. The Institute of Medicine (IOM) emphasizes the importance of nursing's role in healthcare transformation, asserting that nurses should be in a full partnership with other healthcare professionals to redesign American healthcare.³ As full partners, nurses must help drive the changes that affect them most. These changes are heavily influenced by national health IT modernization. It is anticipated that nurses will interact with EHRs even more frequently in the coming years. The IOM asserts that in the future, "virtually every facet of nursing practice in each setting where it is rendered will have significant digital dimension around a core electronic health record."^{1(p384)} Nurses will use the EHR as their primary tool to document, synthesize, and communicate patient data. The impact of health IT and frequent EHR user interaction points to the importance of nursing engagement in EHR selection and adoption.

Nurses and other clinicians have traditionally been passive users of EHR technology. However, as primary consumers, they are significantly affected by EHR software design. One issue with EHR design is the relationship between the user of the system and the buyer of the system, where hospital administrators involved with system purchases may not include nurse users' view of the system, focusing on revenue functions rather than clinical implications.⁴ Nurses should be at the decision-making table, providing valuable user input for EHR evaluation before purchase and adoption. It is important that clinicians focus on patient care, rather than be distracted by clunky technology. Nurses already struggle with limited time to perform the substantial duties of their work. Electronic health records need to be both usable for nurses and relevant to their practice. Leaders from the Alliance for Nursing Informatics have expressed that EHR usability should focus on patient-centered data in order for effective care coordination to occur, with data flowing seamlessly across and within systems.⁵ Another consideration is that patient care settings are not all alike. Clinician workflow and patient care differ tremendously among organizations and often even within an organization. Every nursing environment and health system has a unique roadmap, making an out-of-the-box EHR unable to address specific functionality gaps.⁶ Adopting a usable EHR contributes to safer and higher quality care, along with a better return on investment for the adopting organization.⁷ Some impacts of suboptimal technology can include error generation, decreased productivity, user frustration, and even system deinstallation.⁸ Other concerns for EHRs with poor usability include patient safety, loss of clinician buy-in, and data inaccuracy. Concepts central to EHR design related to human factors (HFs), usability, and human-

computer interaction (HCI) should be incorporated into EHR development and evaluation.

As the largest future EHR consumers, nurses need to be active participants in usability evaluation for EHR adoption. But not all nurses have the appropriate education and technical skills to extensively evaluate EHR usability. For this reason, the informatics nurse specialist (INS) plays a central role in assessing clinical applications, bringing crucial clinical, informatics, and technical knowledge to bear on the process. The conceptual basis of nursing informatics joins nursing science, computer science, and information science to improve nursing practice by communicating and managing data, information, knowledge, and wisdom.⁹ This discipline's unique skill set is what makes the INS such an asset in EHR evaluation and implementation. Therefore, the INS provides a nursing perspective that is vital to successful EHR adoption. The INS role has also become increasingly valued because many project management skills overlap with fundamental nursing skills.¹⁰ The INS excels at helping technical staff understand clinical needs and provides a strong understanding of system feasibility.¹⁰ As a central figure, the INS serves as an informatics expert, working to improve healthcare delivery through the design and use of informatics solutions to support all areas of nursing.⁹ The purpose of this article was to explore the role of the INS in EHR usability evaluation. Background to include definitions and a review of core usability principles will be presented. A framework for applying these concepts will be discussed with the INS at the forefront, guiding the EHR evaluation process.

■ BACKGROUND

Electronic Health Records and Electronic Medical Records

The terms *electronic health record* and *electronic medical record* (EMR) are sometimes used interchangeably but, depending on the context, may have technically different definitions. An EMR is a digital rendition of the clinician's paper chart for a patient encounter, whereas the EHR goes beyond this with a broader view to combine EHRs from multiple clinicians involved in the patient's care.¹¹ Moreover, EHRs can be thought to cross organizations and practices. The IOM defines the EHR as composed of critical building blocks maintained by providers containing (1) a longitudinal collection of electronic health information, (2) immediate electronic access for authorized users, (3) provision of knowledge and decision-support enhancing safety and efficiency, and (4) support of efficient processes for healthcare delivery.¹² Other functions of the EHR include the potential to make health information more accessible at the point of care, reduce medical errors, incorporate standardization in care, and

help decrease health disparities. For the purposes of this article, the term *EHR* will be used to refer to the electronic system that clinicians interact with throughout a variety of healthcare settings.

Usability Principles

Advances in EHR technology should be harnessed in a way that fosters efficiency and safety rather than hindering care. In EHR use, this is performed through incorporating usability concepts into the design of the graphical user interface (GUI). These concepts arise from and are related to HF and HCI studies. *Human factors* is a broad term for concepts about human interactions with tools, considering human needs, abilities, limitations, cognitive aspects, and user-centered design.⁸ The International Standards Organization (ISO) defines usability as “the extent to which a product can be used by specific users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.”^{13(p1056)} Furthermore, Boone¹⁴ relates usability to a bridge that brings together people and machines by reducing effort and errors, maximizing satisfaction, and increasing patient safety. Some of the most pertinent established usability principles include consistency, effective information presentation, naturalness, efficiency, flexibility, and feedback.

CONSISTENCY

Consistency is one of the most important usability concepts for the EHR. Hollin et al¹⁵ define consistency in EHRs as uniformity among functions for the reduction of navigation effort. Consistency can be subdivided into external and internal concepts. External consistency relates to an application’s structure and behaviors having similarity to a user’s experience with other software, while internal consistency uses concepts and behavior that is consistent throughout the software itself.¹⁶ Users can definitely get confused if expected behavior and layout change without reason. An example of this is when the “close” or “exit” button is not always named the same or located in the same region of the screen. While asserting the need for consistency, Stagers^{5(para1)} notes “currently, every EHR has a unique set of icons, displays and information flow... clinicians use more than one EHR and must learn and remember differences in navigation, formats, icons, system quirks as well as location of crucial information.” As users become familiar with the interfaces they have come to trust and understand, they look to other applications to mimic design and functionality. They also expect an EHR to look and act the same from section to section.

EFFECTIVE INFORMATION PRESENTATION

Effective information presentation relates to an interface that incorporates appropriate use of white space, color

that conveys meaning, and overall ease of reading.¹⁶ Presentation is often the first impression and therefore the initial judgment that a user makes on a system. In relation to density, clinical applications can require a large amount of relevant information to display, making density a significant problem. Visual search times and errors increase in proportion to density, and an upper limit of 40% density is appropriate for character-based displays, with GUI displays requiring even less.¹⁶ It is natural for users to look for meaning in color, as it is used for communication in other aspects of our lives, so EHR color use should convey meaning. Cultural conventions of color meaning should be used. Examples of this can be the use of red for danger, blue for cold, and green for normal. Readability plays a key factor in safety. It is recommended to use a font size no smaller than 12 points for important information and 9 points for other information.¹⁶ Quality of presentation described by Zopf-Herling¹⁷ outlines rules of thumb for screen design to include using triggers to guide content, mandating fields sparingly, using visual cues for important information, creating opportunities for evidence-based practice through tools like informative hyperlinks, standardizing data terms, and considering how the data will ultimately display. Although these example guidelines are simple in concept, they have large implications for user understanding and effective use.

NATURALNESS AND REAL-WORLD MATCH

An EHR interface must also be natural, allowing the clinician to be instantly comfortable and familiar with its design. “Naturalness refers to how automatically ‘familiar’ and easy to use the application feels to the user.”^{16(p6)} Factors contributing to this include terminology, design flow, screen flow, and match to expectations. In a study by Hollin et al,¹⁵ clinicians specifically expressed appreciating terminology used that was specific to their distinct field. Naturalness is also tied to a system being intuitive and readily understandable.¹⁵ Navigation of EHR should be based on the clinicians’ normal workflow navigation. Through the use of computer recording, Zheng et al¹⁸ uncovered a frequent pattern in EHR sequencing in an inpatient clinical setting of (1) history of present illness, (2) social history, then (3) assessment and plan. This navigational pattern serves as an example of an excellent starting point for designers to create smooth movement through system interfaces. When EHRs lack naturalness and real-world match, impacts can include user confusion and frustration, making this a key usability aspect to consider for design and evaluation.

EFFICIENCY

Efficiency for an EHR is also a must. Efficiency described by Zopf-Herling¹⁷ outlines models for screen design to

include simplifying clicks through strategically combining information, using checkboxes instead of drop-down boxes where it makes sense, incorporating summary screens, and carrying data forward. Efficiency encompasses optimized workflow through software design that limits clinician work. Clinical documentation can create a bottleneck for time the clinician spends away from patients.¹⁹ Clinicians want software that is easy to use and does not require an exorbitant amount of their already limited time. A direct way to facilitate efficient user interactions is to minimize steps required to complete tasks and provide shortcuts for frequent tasks and experienced users.¹⁶ Efficiency is also at the core of what the EHR is thought to represent for health IT.

FLEXIBILITY AND FEEDBACK

Flexibility in a system is related to how much control users feel they have in their EHR interactions. The road to effective patient care can take many paths, so it is beneficial to create a flexible navigation scheme that can be tailored to a particular medical environment and even customized by individuals.²⁰ It is important to note that too little flexibility can lead to misuse of a system. Excessive control can be the cause of frustration to users and undermine their professionalism.¹⁷ Although there is a need to help guide a clinician, it is best to also allow for professional freedom and accountability. Dr Karen Pinsky asserts that application design should make things easier for the clinician to do the right thing and exert tight control only in truly high-risk aspects of the software.¹⁷ These hard and soft stops are crucial for appropriate use and safety. Feedback and forgiveness in EHR design allow the user to explore the software with control to prevent catastrophic outcomes, informing users about the effects of their actions, affirming their actions, and assisting when training opportunities are limited.¹⁶ These concepts are especially relevant in the clinical setting where errors can have especially high impact on patient care.

APPLICATION OF USABILITY PRINCIPLES AND ROLE OF INFORMATICS NURSE SPECIALIST

It is important that nurses, and especially the INS, participate in EHR evaluation. This evaluation happens during processes of software design, purchase, adaptation, and organization-specific configuration. The National Institute of Standards and Technology (NIST) released an applicable document that outlines formal procedures for evaluating the usability of EHRs, titled the EHR Usability Protocol (EUP).²¹ The EUP details a three-staged framework that consists of (1) EHR application analysis, (2) EHR interface expert review, and (3) EHR user interface validation test-

ing.²¹ The protocol emphasizes thorough evaluation with intensive focus on usability when organizations purchase an EHR. This should be done early to allow vendors an opportunity to make appropriate changes before EHR software reaches clinicians and is used in a live environment. The software must take into account the context in which the EHR will be used, including the users' tasks, characteristics, and workflow.²² The following three-staged framework, based on the EUP, is intended to be used during EHR evaluation at a stage before full implementation, allowing for organizational software adaptation, improvement, and configuration. The role of the INS is the central theme for the application of this framework.

Stage 1: Electronic Health Record Application Analysis

During application analysis, the EHR software should be reviewed for critical use risks relative to a variety of critical issues. The NIST EUP describes this process in five steps: (1) create applicable use case scenarios or test scripts, (2) create application user profiles, (3) identify a realistic use environment, (4) determine critical safety-related issues, and (5) conduct a preliminary assessment overview.²¹ These five steps are described in the NIST framework as typically the responsibility of the application developer but would be better incorporated into EHR adoption evaluation by being the responsibility of the organization's INS. In this respect, the INS serves as a liaison between technical projects and nursing staff, as well as an advocate, coordinator, and voice for nurses during EHR adoption and evaluation.

STEP 1: CREATE APPLICABLE USE CASE SCENARIOS OR TEST SCRIPTS

The INS has an intimate knowledge of use scenarios in the organization of EHR adoption and may also draw upon practicing clinician subject matter experts for input. In EHR application analysis, it is important for the INS to not only consider the application scenarios put forth by the software developer but also create scenarios that specifically represent the organization in which the EHR will be used. This will allow for an evaluation process that reflects pertinent use of the proposed software.

STEP 2: CREATE APPLICATION USER PROFILES

The INS will define which user groups will interact with the specified EHR. These user groups need to be defined with a thoughtful approach to guide future software setup. This future setup could dictate group access, view design, and other aspects of the EHR that may be configured on a group level. The INS's clinical background provides strength in this area for understanding clinical documentation.

STEP 3: IDENTIFY A REALISTIC USE ENVIRONMENT

The environment in which clinicians will use the application may include a variety of factors such as lighting, noise, and ergonomics that could affect application use.²¹ This environment needs to be identified to foster testing that is as close to reality as possible. The INS can provide accurate descriptions or simulations of the environment in use at the organization. This may include disruptive factors such as simulated interruptions with telephone calls, pagers, and questions from peers. The INS may use organization-specific equipment with audio alarms such as infusion pumps and vital sign monitors as part of the scenarios. The INS can also provide insight to past experience related to the clinical environment for this part of evaluation.

STEP 4: DETERMINE CRITICAL SAFETY-RELATED ISSUES

Within each scenario, the critical steps that may have patient safety implications should be identified as errors of either commission or omission, along with potential adverse outcomes and/or root causes.²¹ It is advised that the INS utilize organizational resources for this step, such as the patient safety director, to facilitate minimum patient safety requirements and help identify safety requirements. Other safety-related concerns could be drawn from The Joint Commission National Patient Safety Goals (NPSGs), which include items such as patient identifiers, critical test results, and surgical site identification.²³ It is imperative that these NPSGs are incorporated into EHR software design to assist clinicians in adhering to national standards.

STEP 5: PRELIMINARY ASSESSMENT OVERVIEW

This first stage should end with a description of the EHR usability evaluation that is provided by the application development team.²¹ The INS should also prepare a similar comparable document that encompasses the organization's perspective of a tailored assessment overview. These two assessments should then be synthesized, categorized, and reviewed for outstanding and critical issues. The combined document can be used as a reference guide for future use in the evaluation process. It can also be used when producing software change requests before or after the EHR is implemented and used by clinicians.

Stage 2: Expert Review

The EUP advocates that a multidisciplinary team including usability/HF experts be used along with medical professionals in this stage of review. For the purposes of an organization reviewing commercial off the shelf (COTS) EHR software to incorporate into their practice, an alternative can be to formulate a local team for this evaluation.

The INS can create a team composed of staff representative of intended EHR users. This team can be assigned local EHR evaluation, referencing the previously mentioned usability concepts as a minimum set of requirements. It is important that the local team utilizes evidence-based research to guide their focused usability testing and uses a variety of tools. Some of the most recognized usability guidance is available from experts like Jakob Nielson or Ben Shneiderman and organizations such as NIST, ISO, and Healthcare Information Management Systems Society. It is arguable that these concepts are simple enough to be applied to software review by nonexperts like the clinical users themselves. This local team can take the place of experts as they hold personal knowledge of their own workflow and can identify how the EHR may or may not fit into their respective practice. The NIST EUP recommends that, for independence in the review process, each expert review the software alone and produce written findings, and a lead expert consolidate findings into a single categorized report.²¹ The INS should act as the lead expert to consolidate and categorize findings.

Stage 3: Interface Validation Testing

Interface validation testing is conducted before EHR software is implemented for clinician use. Successful validation requires a well-designed application that has benefited from careful, user-centered design and is a tool to help health IT developers confirm the validity of their assumptions about use cases, verifying design principles applied during development.²¹ For clinicians and the INS, this is the most important step as it could be one of the last opportunities to request organization-specific software modifications. A variety of participants should be included in this phase of testing, such as testers who have been previously exposed to the software and others who have not. Testers who have not seen the software may have a unique perspective and ability to find issues that others have overlooked. Often, vendors will provide preset test scenarios, which may be used in the testing environment, but this should not be the only tool used in the process. The application scenarios created by the INS during the first stage (application analysis) should also be used to verify that organization-specific scenarios are tested. It is important to allow testers to perform freestyle testing to find issues potentially undiscovered. Clinician testers have an intimate knowledge of workarounds or multiple paths to meet a given task and can expose software issues through this kind of exploration.

The EUP provides a framework for EHR usability evaluation, and the INS plays an essential role in guiding this process. Major steps in evaluating usability of EHR software include expert analysis, expert review, and validation testing. These steps are usually part of the process that COTS software developers undergo when preparing their

EHR software for certification. However, this process can be adapted and reapplied by organizations seeking to incorporate these EHR COTS into their own practice. It is important to include an INS as a key player and possibly local project manager for the EHR evaluation process. Including clinician end users in the evaluation may contribute to understanding the way a proposed EHR may or may not fit into the actual practice environment.

CONCLUSION

Nurses are deeply affected by EHRs, since they are the largest group of users, making it vital that the discipline be involved in evaluating the software. Because nursing practice is complex and important, nurses should utilize software that facilitates this valued work. But the performance of an EHR depends on how well it is designed. Usability concepts such as consistency, effective information presentation, naturalness, efficiency, flexibility, and feedback provide minimum guidance for EHR evaluation. Consistency in EHRs means that language and behavior do not change as a user moves through the software. Information must be presented in a way that is effective and helps prevent errors. Moreover, EHRs should be understandable, natural, and reflect the work that users perform. Efficiency is at the core of EHR use and serves as a minimum requirement for implementation. This means that EHR software should help clinicians, and not hinder them. It is crucial for EHRs to also provide decision support such as warning users when adverse effects are imminent and allowing users an opt-out choice. Nursing's complex practice also calls for EHR design that is flexible, allowing workflow variances to be honored.

The INS is in a unique position to understand both the clinical and technical sides of EHR evaluation, and this role is critical to the success of EHR adoption. Therefore, the INS must be at the forefront of usability testing, bringing informatics and nursing expertise to the process and serving as a liaison to the clinical end users. Usability concepts are of fundamental interest to the INS, especially the relationship between the nurse and the EHR interface. It is the INS who can best identify and express the gaps between nursing workflow and EHR design. The EUP is intended to promote user-centered EHR development that focuses on safety through usability.²¹ The INS can lead meaningful EHR usability evaluation, using the EUP as a framework for applying relevant usability principles. Key activities in this framework include expert analysis, expert review, and validation testing.

A primary concern related to EHR adoption is that it may increase the amount of time clinicians spend on documentation.²⁴ For this reason, practicing clinicians must be included in validation testing since they can provide an intimate knowledge of workflow and documentation

needs. Experts from all disciplines and specialties affected by proposed EHR implementation should also be included in the evaluation process to ensure that all stakeholders provide input to system design. By including clinicians during EHR evaluation, the INS can avert any potential issues or concerns about system functions and usability.

Future Expectations

Many experts and policymakers predict that EHR adoption will rapidly increase in the upcoming years.²⁵ Because the nursing profession is a dominant presence in the healthcare workforce, the discipline will play an important role in the success of EHR adoption in the future. The HITECH Act Meaningful Use stage 2, set to go into effect in 2014, includes a requirement for user-centered design in EHR technology as a condition for certification.²⁶ Nurses want EHRs that help them to work smarter, do not bury needed content, and are easy to read and understand. Health IT will be a key factor in the practice of nursing and healthcare in the next generation, and the impact on the workforce is still very poorly understood.² It is anticipated that the next 5 years will bring near universal EHR adoption, making it timely to examine both intended and unintended consequences.⁴ Many usability experts encourage future EHR developers to apply user-centered design into their development as these practices have proven successful in other industries like aviation, transportation, and nuclear power.²¹ Usable products will also create competition among vendors of future EHRs and provide an edge for those vendors who can offer the most usable products.

As health IT is fundamentally changing the way that nurses practice, it is likely that more nurses will seek leadership positions in the field of informatics. Advances in technology will affect the INS, challenging the field to adapt while continuing to apply foundational discipline-related issues to future technological challenges. Organizations may also move to support more employment and investment in the INS role. Usability is a collective duty among end users, the INS, and EHR developers. There is more to usability than visual appeal. Testing software through usability evaluation will reveal whether the software can actually meet users' needs efficiently and effectively as well as decrease errors and improve the quality of care. Expectations are, with advances in technology and enhanced software sophistication, more usability concepts will be incorporated into well-designed EHR systems with the guidance of the INS.

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