Identifying and Addressing Critical Usability Issues to Strengthen Nurses' Interactions with Health IT

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Abstract. Technology usability, especially electronic health record (EHR) usability, is a global concern for clinicians. Despite critical user experience (UX) issues, nurses are not vocal about interactions with health IT. The purpose of this project was to identify nurses' health IT UX issues and propose solutions for them. Using a snowball sampling technique, 25 experts were interviewed using a semi-structured format. Three themes emerged from content analysis (1) The Burdens of Health IT, (2) The Voice of Nursing, and (3) We Need a New Vision. Lack of cognitive support underscores the burden theme. The voice of nursing is missing throughout the systems life cycle, and a need exists for new visions of EHRs and training delivery. Solutions include the need for national leadership, modular redesign of EHRs to support the way nurses think and do work, and a concerted effort to incorporate UX methods into health IT design in the future.

Keywords: User experience · Usability · Nurses · Health information technology · Electronic health records

1 Introduction

Technology usability, especially electronic health record (EHR) usability, is a global concern for clinicians. In the U.S., physicians are exceptionally vocal about poor EHR usability and impacts on their productivity as well as their reimbursement. The American Medical Association and 30 other medical organizations wrote to the Office of the National Coordinator for health Information Technology (IT) deploring EHR usability and provided six recommendations for essential EHR usability [1]. In late March 2015, EHR issues became an epicenter of health IT user experience (UX) difficulties when The Joint Commission (TJC), a U.S. accrediting body for health organizations, created a new alert concerning health IT-related sentinel events. TJC completed an analysis of 3,375 adverse event reports from January 2010 to June 2013. These included 120 health

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IT-related sentinel events [2]. A full one-third of these events emanated from computer-user interface issues and another 24 % were related to workflow and communication issues. TJC issued the alert because these kinds of issues can affect patient safety, clinician productivity and organizational quality measures.

At 3.1 million professionals, nursing is the largest group interacting with health IT nationally in the U.S. [3] and globally. As seen in Fig. 1, nurses represent the largest number of EHR users in the U.S. and they experience critical user experience issues with EHRs as well as other health IT. These issues are different than those for more vocal professionals such as physicians. Yet, nurses are less outspoken about their UX issues.

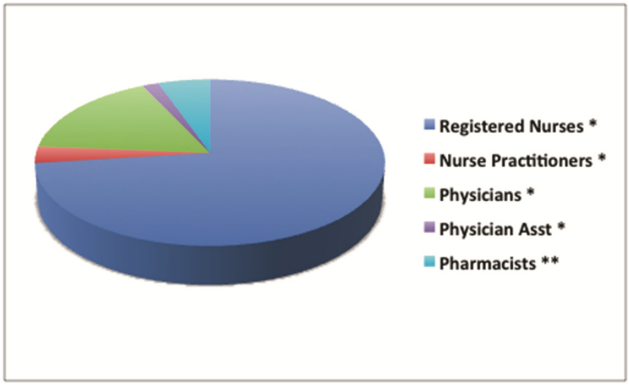

Fig. 1. Proportion of RNs to Other Professions in the U.S.* http://kff.org/state-category/providers-service-use/, 2016 ** http://www.bls.gov/oes/current/oes291051.htm, 2014. (Color figure online)

Individual research studies are available on the topic of nurses and UX issues, though a national view does not yet exist. For example, Drew and colleagues observed nurses responding to 2,558,760 unique alarms generated by physiological monitors over a month's time in five intensive care units. A full 88 % were false positives for arrhythmias, impacting productivity and creating issues with alarm fatigue [4]. A usability evaluation by Staggers et al. examined barcode medication administration design and found 99 usability problems, 15 of which were classified as catastrophic due to the potential for patient harm [5]. The sum total of the issues impacted patient safety, nurses' productivity and being able to obtain the "big picture" of the patient in 150 Veterans Administration facilities using this application in the U.S.

In addition to EHRs, the work of nursing increasingly includes point-of-care devices such as smart intravenous medication infusion pumps, which incorporate information technology that is like a desktop computer [6]. These system and device interfaces are therefore becoming more complex. Many of these devices and systems are products purchased from different vendors resulting in multiple complex interfaces, using different interaction designs that must be mastered before they can be used efficiently and effectively.

The healthcare model is also evolving in the U.S., with increased involvement of information and communication technologies to care for patients in their homes, provide

telehealth services and make use of health apps that are used on smart devices to track and manage chronic conditions [7]. As patients with chronic conditions and lower acuity health problems are being pushed back into their homes, patients who are admitted to hospitals are more seriously ill than in the past [8]. One could argue that caring for these complex patients increases information needs, requiring nurses to interact with health IT even more frequently. In fact, nursing will be increasingly called on to work with patients and existing/emerging technologies to improve patient outcomes. Equally important is that nurses will need to act in their traditional role as patient advocates in this technology-rich environment.

These recent studies and care complexity issues likely identify only the tip of the iceberg of nurses' current UX concerns. No systematic methods exists to collate and analyze UX issues for any health professional group. Therefore, the purpose of this project was to describe nurses' usability issues with health IT and to develop recommendations for improving health IT usability for nurses. The project was sponsored by the Health Information Management and Systems Society (HIMSS) User Experience and Nursing Communities as well as the American Nurses Association.

2 Methods

This project was conducted under the guise of a 5-member team from the HIMSS User Experience (UX) Committee. Team members are the authors of this paper. This descriptive, exploratory project included two phases. In the first phase of the study, requests for usability case studies were distributed via informatics and the American Nurses Association list serves. Second, snowball sampling was used to select national nursing, nursing informatics and UX leaders and experts for interviews. After obtaining participants' consent, the team used a semi-structured interviewing technique with probes to interact with experts. The interviewers used a structured script to ask participants to describe critical usability issues for nurses in their interactions with health IT. Follow-up questions asked participants to describe the significance of the issues, why they thought they occurred, the prevalence of issues in other sites and last, experts were asked to identify solutions for UX issues. Interviews were audio-recorded; extensive notes were taken and independently verified by two team members. Content analysis was used to analyze the data [9, 10] and to identify appropriate, preliminary thematic content.

3 Results

For the first phase, the listserve requests went to thousands of nurses, but the request for case studies resulted in only 12 uneven submissions, making this method ineffective and the data not representative. The second phase included interviews with 25 experts who were UX professionals (4), nursing informatics/nursing UX leaders (9), UX nurse researchers (6) and site leaders such as chief nursing or medical informatics officers (6). The representation was across federal/non-federal institutions, acute care and long-term care, various health IT vendors, and academic/non-academic organizations. Twenty of the participants were professional nurses who had expertise in UX and health IT.

Interviews lasted an average of 25 min with a range of 18–55 min. The results in this paper represent preliminary analyses of the interview data.

3.1 Themes on UX Issues and Solutions

Three themes emerged through preliminary content analyses (1) *The Burdens of Health IT* (2) *The Voice of Nursing* and (3) *We Need a New Vision*. Discussion of each follows.

The Burdens of Health IT. This theme includes myriad design and technical issues. Experts indicated health IT developers do not yet understand nurses' work or cognitive processes so these are not reflected in current technology design. For example, the work of nursing includes non-linear where tasks, such as medication administration, often clustered across multiple patients. In contrast, EHRs are designed to allow a view of one patient's information at a time, making information retrieval difficult to support clustered activities. Moreover, as one UX expert noted, EHRs miss the main points about nurses' activities. An example concerns barcode medication administration which focuses on assuring the medication in hand is being given to the correct patient, but it does not support higher level cognitive activities such as, "Is this even the right medication for this patient given her condition?" or "Do the patients' symptoms indicate another medication might be superior?" Another example is deploying an adult EHR in a pediatric setting creating a mismatch of care requirements, e.g., for weight-based dosing and age-based care, resulting in increased patient safety issues and inefficiencies.

As a snapshot of the health IT burdens, a nurse-author who was interviewed for this project published her accounting of interactions with her site's EHR:

I do understand why thoroughness in documentation matters legally, but sometimes wonder if sadists designed our software. It should not be easier to order a sweater from Lands End than to chart on my patients, but it is. Click, scroll, type, enter. Here's the menu with twenty choices, none of them the one I need. Here's the point where I need information from two different screens, but there's no way to toggle between them. Here's the screen with thirty discrete options to check, but the window it opens up only shows me five at a time. New lab results, X-rays, CT scans, MRIs: none of those generate an alert and the screen is full of minute icons, some of which represent functions I don't use or even understand [11].

These kinds of cognitive-task mismatches result in not only a lack of health IT support for the cognitive processes that are at the core of nursing practice, but a frustration that comes from increased cognitive burdens. Similarly a UX expert indicated that not all nursing activities are "orderables," meaning not all are driven by physician-related orders, a dependent activity central to EHR interactions. In addition to and dependent and inter-dependent activities, nurses perform independent activities. For instance, nurses' independent discharge teaching may uncover the fact that an older patient has no one to care for him at home, a fact that could contribute to a readmission within 30 days and greater morbidity.

More important, nurses are knowledge workers who must think critically about patients and their care. The current design of EHRs can impede this thinking. A prime example is the EHR design and federal requirements that have resulted in extensive

documentation requirements for nurses, especially around entering data for others' needs such as for quality improvement departments and to meet new federal guidelines, e.g., Meaningful Use. One expert counted the number of clicks to enter a nursing admission assessment: 532. Assessments alone can take 30–60 min of a shift to chart, according to experts. Moreover, finding pertinent data in the sea of text is difficult.

Designs are particularly problematic for information synthesis around handoffs, medication management, and communication activities. Care handoffs, as noted by many experts in this project, are a particular source of UX "pain points" [12, 13] because nurses must conduct "information foraging" in the EHR to construct the full picture of patients' episodes of care.

The impacts of these health IT pain points occur across all healthcare delivery sites and vendors. Patient safety is at risk when the goals around patient care get lost as nurses struggle to use health IT. Inefficiencies are a particular impact and can result in delays in decision making and care rendered, e.g., a 1.5 h delay in the administration of pain meds during a system downtime experienced by one expert.

Organizations typically purchase disparate systems and smart point-of-care testing devices resulting in poor interoperability and data isolation. Information is siloed between fragmented systems and in devices such as vital sign machines that are not integrated with EHRs. Despite these issues, nurses are expected to adopt and use these systems, a real technology dilemma. Hybrid systems using both technology and paper are also common which further increases data isolation. The lack of interoperability and hybrid systems hinder both the nurse's ability to locate information quickly and obtain the holistic patient view required to provide safe and appropriate patient care.

The *Burdens of Health IT* theme also includes perceived time away from patients due to increased interaction time with technology. This decreases the nurses' awareness of their patient's status. All these IT burdens result in inefficiencies. Work-arounds, lack of fit to workflow, loss of productivity and threats to patient safety are outcomes of the health IT burden for nurses.

The Voice of Nursing. The *Voice of Nursing* is absent in all the phases of the health IT systems lifecycle from the selecting, purchasing, developing/tailoring and implementing processes. If nurses are present in the selection/purchasing process they are often an executive who does not represent the voice of the point-of-care nurse who will be using the purchased system. While nurses may be consulted during the tailoring or development process, this consulting is typically more casual and informal. UX methods are seldom employed (although they are being increasingly used by health IT vendors). Implementation processes do include nurses, although the extent of involvement is under-representative of the numbers of nurses in both acute and longterm care facilities.

Because of this, health IT systems and tools are seen as a "no-win" for many nurses, who must simply use without complaint whatever technology appears in their facilities. Unlike physicians, nurses are employed by the institution, giving them little recourse if EHRs are purchased without an end-user viewpoint or if technology is not integrated.

Experts thought nurses often received inadequate and inconsistent training. Typically go-live or new personnel training was provided, but no training was done after that. Training

models are often "train the trainer," meaning that training and education quality and effectiveness eroded over time once the initial expert trainer left the site.

A New Vision for EHRs. Despite the progress for EHRs globally, new visions for this technology are necessary. A main re-envisioning would be designing acute and longterm care EHRs with a patient-centered focus. For inpatient care, the current focus is primarily internal processes for departments – laboratory, radiology, pharmacy, etc. Orders management modules are typically "glued" over these functions. Data are aggregated by patient identification numbers for results and orders, but EHRs do not yet support full processes of care such as seeing the "picture of the patient" or even having relevant data integrated across intra-facility or external sites around the reason for admission. A simple example is following patients as they traverse across the surgical process from admission to the operating room (OR) to the post-anesthesia care unit (PACU) to intensive care (ICU) to a surgical floor and then to home and follow-up with their surgeon and primary care provider. Current EHRs do not show integrated data for these patients such as estimated blood loss from the OR or even medications given intraoperatively once patients leave the OR/PACU setting.

Supporting care for complex patients is even more difficult. For instance, oncology patients are seen by myriad health professionals in myriad departments both in and outside a facility supported by a particular EHR. Some data, such as chemotherapy or TPN (total parental nutrition) may still be on paper versus in electronic media. Issues are compounded in long-term care when even basic connectivity and integration challenges are amplified. For example, skilled nursing facilities rely on outside labs and radiology, so lack of this basic integration results in a paucity of patient-centered information. Creating a full accounting of care is difficult at best in any setting. Having a patient-centered focus would mean re-designing EHRs to support these transitions, data syntheses and "telling the story" of the patient across settings and units.

Another expert suggested re-envisioning EHRs as a communication (versus billing or physician-centric) system. Communication is central to patient care, especially in the acute care setting. Current EHRs were not designed with this requirement in mind. Current communication is done by phone, email and verbal methods as well as, to a lesser extent, by clinical notes. Complex patients generate hundreds of separate notes filed in EHRs, making it difficult to track relevant and timely information. Instead, communication is often informal and frequently verbal.

Last, several experts suggested the need for new education and training models that include training beyond mere go-live. In particular, training models should be discipline-specific and based upon workflow. Although none of the experts recommended de-installing technology, critical improvements are needed in the near future.

4 Discussion and Conclusions

This preliminary analysis shows that nurses experience significant health IT usability issues, some that can result in increased risk to patient outcomes. Significant health IT design issues exist across settings, particularly for handoffs, medication management and communication activities. Experts thought the voice of nursing was missing in all

phases of the systems lifecycle and they suggested new visions for the redesign of technology to support acute and longterm care. Nurses are experiencing increased cognitive burden from the very technology whose purported benefit is that it is supposed to reduce the burden of care as well as the risk of patient harm.

The reasons bedside nurses did not respond to our initial request to share their health IT experiences are not clear, but several reasons are possible. First, point-of-care and bedside nurses are focused on patient care needs at the moment. Most nurses are under severe time constraints as they care for patients, and they also may think they just have to adapt to whatever technology an organization deploys. Nurses often work in survival mode to assure adequate care is rendered during a shift. Managing or improving technology can be well beyond their primary goal of completing patient care. Another expert mentioned that once a work-around is created to a UX issue, nurses may see the issue as resolved and not requiring attention. Nurses can feel that they have no voice in technology decisions or as experts in this study indicated, they may not even know to whom to take their issues and complaints about health IT. Last, fear of retribution was mentioned during informal discussions and interviews. Nurses who speak out may find they are labeled as trouble-makers or their performance evaluations may identify them as not being team players.

4.1 Health IT Transformation

Solutions identified by the participants require that we look beyond the installed base and think of health IT as a process of continual, incremental transformation. Most organizations have installed technology, and, as noted earlier, de-installation will not help them attain their institutional and patient experience goals.

Partnering is required among health IT vendors, healthcare organizations, UX professionals and nurses to guide the evolution of health IT and support patient and organizational needs. The voice of the largest group of health IT users can give vendors the real-world feedback they need to support the process of care transformation. The voice of nursing

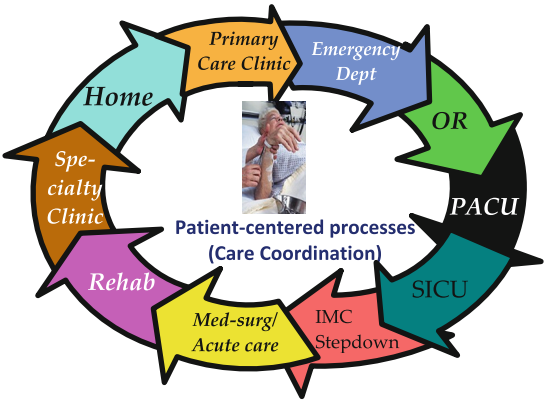

Fig. 2. A Model of Patient-Centered, Communication Health IT Copyright Nancy Staggers, 2015. Reprinted with permission.

can also guide organizations in the purchase and effective use of tools and systems that represent significant costs in budgets. The impact of incorporating UX professionals into the partnership will serve as a bridge between the nurses and the efforts of vendors to transform health IT ensuring a continuous feedback loop.

In addition to partnering, a new vision of health IT is needed: as a patient-centered communication system (see Fig. 2). Technology is seen as a triad of care support: technology, patient and nurse. The new vision must also consider health IT as part of an ecosystem that can bring risk and gains. Leaders may think EHR redesign is overwhelming, but one UX expert suggested using a modular approach to redesign versus a whole-scale overhaul. This approach is successfully used by Goggle. For example, medications management or handoffs could serve as a starting point.

4.2 Standardization

Standardization was also identified as an essential solution across a number of entities and issues. Standardization is needed in areas from health IT design guidelines from developers/vendors to documentation standards at a national level. For instance, each site currently tailors a vendor's system de novo and also develops its own set of nursing assessment forms. However, an admission assessment to a neonatal intensive care unit in San Francisco is unlikely to be very different from one in New York City. Thus, an opportunity for standardization is available nationally and to some extent, globally.

Standardization for technology project implementations and training also exists. Again, each organization designs its education and training de novo. While some peculiarities within sites exists, most training can be standardized according to the product being implemented. Known project management principles can be employed. Continual and refresher training could reduce variability in health IT interaction quality. Training would also be designed using workflow pertinent to user groups.

4.3 The Voice of Nursing

Nurses are knowledge workers and act as an information and communication hub for the healthcare team; thus, nurses' voices must be reflected in technology design, purchasing, deployment and evaluation.

The voice of nursing around health IT is also needed at all levels in a healthcare organization. Nurses' role as patient advocate extends to health IT so nursing input into purchasing, design and tailoring decisions is essential. Successful organizations will recognize nurses as knowledge workers engaged in complex activities which are currently poorly understood by others.

This means that increased nursing leadership is needed on UX issues in health IT. Nursing needs a digital strategy, a strategic direction that focuses on why nurses use particular technology, what health IT does and what it can do to support the evolution of nursing practice. In the plan, a home needs to be assigned for nursing UX issues, both locally and a home for UX issues is needed nationally. Clinicians need the ability to collect UX issues and find solutions for them.

4.4 Uptake of UX Tools

Tools exist for integrating UX professionals, their practices and methods. These include the HIMSS Usability Maturity Model, National Institutes for Standards and Technology (NIST) usability documents and SAFER guidelines. The HIMSS Usability Maturity Model was developed by the HIMSS UX committee and is tailored to the health IT domain. It describes 5 stages of organizational maturity for UX and provides steps to attain each stages [14]. NIST has created a series of documents for the design and testing of EHRs, e.g., NIST 7804 on evaluating EHR designs [15]. Last, the U.S. Office of the National Coordinator for Health IT created SAFER guides. These are guides for organizational self-assessment in safe use of health IT such as: High priority practices, contingency planning, system configuration, system interfaces and computerized provider order entry [16].

Experts in this project agreed that current technology designs do not support nurses' work or provide needed cognitive support. Impacts span patients, nurses, local organizations and the national healthcare system. Clearly, EHRs must be re-conceptualized to be patient-centered, to support communication, to be interoperable and to support team-based processes. The voice of nursing must be included in all phases of the systems lifecycle.

4.5 Significance and Comparison with the Literature

The results of this project demonstrate widespread UX issues for nurses in both acute and longterm care. The impacts are non-trivial: risks to patient safety, increased cognitive burdens, loss of productivity and other inefficiencies. This project provides a national snapshot of the state of UX affairs with health IT in the U.S. Thus, it expands what is known for individual UX studies.

This project bolsters available literature cited earlier. It is also consistent with a recently released report from the National Quality Foundation [17]. The report outlines the potential for health IT to create new hazards and recommends a framework for health IT safety measurement. Of importance here, one of the key areas is including user-centered design methods and testing to promote health IT safety.

5 Future Research and Project Limitations

Future research might include systematic assessments of novel designs to solve complex health IT issues identified here particularly for care transitions (handoffs), medication management and care communication. Researchers might develop and evaluate future visions for health IT and/or EHRs to promote safety and efficiency. Limitations to this project include the lack of sampling for clinical areas outside acute and long-term care such as telehealth, public health and home health. Future researchers may wish to conduct a similar project for those areas. The project lacked the view of point-of-care nurses, despite our efforts at requesting their input. However, site experts interviewed in this project should have been able to represent their views. Future researchers may want to interview nurses in person versus listserve requests.

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