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Nursing Satisfaction with the Electronic Medical Record: Implementing Meaningful Change at Seattle Children's Hospital

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Nursing Satisfaction with the Electronic Medical Record:
Implementing Meaningful Change at Seattle Children's Hospital

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NURSING SATISFACTION WITH THE EMR

Table of Contents

Abstract 3

Background 4

Purpose..... 5

Review of Literature 6

 Synthesis 15

 Critique 16

Conceptual Framework 16

Methodology 17

Results / Outcomes 21

Discussion 26

Recommendations..... 29

References 31

Appendix 35

 Appendix A 35

 Appendix B 36

 Appendix C 38

NURSING SATISFACTION WITH THE EMR

Abstract

Purpose: The purpose of this study is to describe nursing use, quality, and satisfaction with the electronic medical record before and during the course of the electronic medical record transition. In addition, this study examines the differences between nurse age, role, and area of work as these demographics relate to nursing use, quality, and satisfaction. Background: Nurses spend a large part of their shift using technology, including the electronic medical record, however the use, quality, and satisfaction of this tool as it relates to the nursing profession has not been formally evaluated. Methods: The design of this study is an analytic observational cohort study. Data was collected via survey responses from the nursing staff at Seattle Children's Hospital pre and post a series of nursing led electronic medical record design sessions. Results: Nursing care coordinators reported the highest satisfaction (3.9 ± 0.9). Acute care RNs reported the highest satisfied clinical area (3.8 ± 0.9), and the highest satisfied age range was 60+ (3.6 ± 0.9). Finally, the highest satisfied tenure range occurred between 6-10 years (3.7 ± 1.0). Conclusion: There are differences between nursing satisfaction with the electronic medical record based on demographic variables. In addition, formatively evaluating nursing satisfaction with the electronic medical record represents a useful exercise that could benefit both individual organizations as well as the field of nursing informatics.

Keywords: electronic medical record, nursing satisfaction, nursing informatics

NURSING SATISFACTION WITH THE EMR

Nursing Satisfaction with the Electronic Medical Record: Implementing Meaningful Change at Seattle Children's Hospital

Electronic medical records (EMRs) are a type of information system designed to improve patient safety, patient satisfaction, and organizational care efficiencies. In the United States, EMRs have become common place in almost all healthcare facilities, with widespread adoption encouraged by many insurance payors. However, evaluation of EMRs from the clinical nurses' standpoint has received little academic or clinical attention. To date, there is only one validated instrument for evaluating nurses' use, quality, and satisfaction with EMRs as a measure of EMR effectiveness (Otieno, Toyama, Asonuma, Kanai-Pak, & Naitoh, 2007). This is concerning, as there is evidence to support a critical need for further analysis of EMR content, particularly around nursing documentation (Hayrinen, Saranto, & Nykanen, 2008). In addition, nurses spend approximately 33% of their shift using information technology devices such as the EMR (Higgins, et al., 2017). Our healthcare community has embraced a quality improvement approach to improving our clinical practice, however this quality improvement culture has not fully translated to information technology. Creating a validated nursing focused EMR assessment tool using an information science framework could help organizations further optimize current EMRs, resulting in increased organizational effectiveness, nursing retention, and improved patient care outcomes.

The academic pursuit of evaluating an end-user's satisfaction with the EMR as a measure of success is a moderately new idea. In 2010 President Obama signed the Health Information Technology for Economic and Clinical Health (HITECH) Act; this act encouraged the US health care system to transition away from paper-based documentation to a technology-driven industry focused on improving patient outcomes (Jha, 2012). It was this act that inspired many healthcare

NURSING SATISFACTION WITH THE EMR

organizations to fully adopt EMRs. Meaning, widespread EMR use became normal just over 10 years ago. Organizations invest large amounts of time and money into EMRs (Berner, Detmer, & Simborg, 2005), however only in the past few years have professional organizations started to consider re-evaluating the initial EMRs installed shortly after the HITECH act was signed 10 years ago. As a result, one of the most expensive and time intensive instruments healthcare organizations implement has lacked thoughtful and longitudinal research.

As previously stated, the evaluation of EMRs from a user-satisfaction perspective is a relatively new endeavor. Most current research is focused on physicians, or an aggregate of multidisciplinary end users; there are few published studies that evaluate the nursing profession's use and satisfaction of EMRs as a single discipline. While the field of patient care delivery is traditionally multidisciplinary, a user's interaction with the EMR is extremely different based on one's role. For example, nurses focus much of their time inputting data into the EMR, whereas providers spend much of their time reviewing data in the EMR. For comparison, this could be likened to the difference between typing a paper in Microsoft Word, versus reading that same paper in Microsoft Word. The lack of standardized evaluation tools for nursing's use of EMRs represents a true organizational and information science deficit. The widely used plan, do, study, act cycle will remain hindered in optimizing EMRs for nursing until a solid baseline is achieved.

Purpose

The primary aim of this project is to describe nursing use, quality, and satisfaction with the EMR before and during the course of EMR transition. In addition, the secondary aims include identifying a baseline satisfaction level, exploring differences between demographics and nurse satisfaction, and examining the internal consistency of the selected instrument.

NURSING SATISFACTION WITH THE EMR

Review of Literature

Much of the literature currently published around clinician's use of EMRs can be organized into four categories: design of the system, user acceptance of the system, resultant impact on quality of patient care, and implementation and evaluation of information systems. Succinctly, design, acceptance, quality of care, and implementation are the common areas of focus. While these are all important areas of research, there are few articles amongst any category that focus solely on the needs of nursing. In addition, there is no broadly accepted tool for evaluating nursing's views on design, acceptance, quality of care, and implementation. Most studies rely upon a home-grown survey combined with structured interviews. While these studies offer useful evidence, none of them offer strong reliability or content validity. In addition, there are multiple EMR vendors privately owned, which makes comparative evaluation challenging. Ultimately, the scope of this clinical issue extends to almost every single healthcare professional in the United States – regardless of the specific discipline or care setting.

Design

Most clinicians use the word *design* to describe how an EMR is built and displayed, however the word *usability* is most commonly used to define the design of an EMR in the information science field. The usability of EMRs continues to be a dissatisfier for providers, however the bulk of published studies focus on doctors and nurse practitioners, also termed providers (Ratwani, Fairbanks, Hettinger, & Benda, 2015). The literature has identified that organizational recognition of nursing's unique needs during the design process of EMRs can increase the resilience of nurses when using the EMR (Bristol, Nibbelink, Gephart, & Carrington, 2018). In fact, that same study found themes of nurses intentionally disregarding components of the EMR that were deemed ineffective and poorly designed, this phenomenon

NURSING SATISFACTION WITH THE EMR

was named positive deviance, meaning nurses were intentionally working against the EMR when they felt patient care suffered because of the EMR design (Bristol, Nibbelink, Gephart, & Carrington, 2018). Organizations can pay keen attention to nursing's needs by ensuring a user-centered design process, meaning, focusing on the user (nurse's) needs when designing the system. However, the literature has yet to identify one accepted way of ensuring user-centered design for nursing. Three themes have been identified that impact design and user perceptions: competing priorities, need for intentional actions to balance technology, and need for additional time and practice (Graham, Nussdofer, & Beal, 2018). While helpful, the direct application of these themes towards user-centered design for nursing documentation remains vague.

The usability, or design, phase of EMR projects is arguably the most important. Poor usability will undoubtedly lead to poor acceptance, stagnant care metrics, and poor implementation and evaluation of future EMR systems. This could translate into long term organizational impacts including decreased nursing retention and decreased insurance payor reimbursement rates.

Acceptance

Embracing and full acceptance of EMRs is the metaphorical pot of gold at the end of the rainbow; hospitals and clinics constantly strive for full acceptance, but few (if any) achieve it. There are many obvious factors that impact acceptance: poor design, hurried training, and workflow misalignment, to name a few. Interestingly, one study identified that the nurses most likely to identify a positive attitude (acceptance) towards EMRs are those that work less than 30 hours per week, work primarily in a hospital, and have prior experience using EMRs (de Veer & Francke, 2010). While knowing the ideal user is helpful, the nursing profession is extremely varied in practice location and average age, making this information poorly generalizable. One

NURSING SATISFACTION WITH THE EMR

study evaluated nurses' experiences with EMRs in Texas and found that the profession demonstrated positive support for EMRs, however called upon vendors and administrators to improve the systems on behalf of the nursing profession for their patients (McBride, Tietze, Hanley, & Thomas, 2017). The literature has also identified that nurses are unable to respond positively to EMRs if a time reduction in documentation duration is not clearly assured (Gonzalez, et al., 2015). This provides a key point of recognition for organizations: preventing documentation overburden is a coveted metric of success for nurses, and likely plays a direct impact on overall adoption of the system. Overall, it appears the nursing profession is still highly engaged in achieving acceptance of EMRs, however, is also advocating for some improvements. The improvements are not clearly identified in nursing literature.

In broadening the literature review to include multidisciplinary healthcare fields, the themes of compatibility, security, and accuracy are identified as clear impacts on end-user's attitudes and acceptance of EMRs (Mijin, Jang, Choi, & Khongorzul, 2019). Further review identifies that the involvement of end-users during the bulk of implementation and ongoing evaluation of the system also positively impacts acceptance of EMRs (D'Costa & Sinha, 2018). In the area of acceptance, it appears the nursing and broader medical literature is aligned; clinicians are currently dissatisfied with EMRs and call upon organizations and vendors to pay more detailed attention to user-centered design, compatibility (interoperability of systems), system security, and system accuracy. Improvement in these categories could help increase overall acceptance of EMRs.

Quality of Care

Nurses are inherently called to provide the highest quality of care to their patients. Ideally, EMRs would support the quality of care provided to patients by nurses. It has been

NURSING SATISFACTION WITH THE EMR

documented that post implementation of EMRs, nurses reported spending more time overall within patient rooms performing and documenting nursing interventions, but less time providing patient-family teaching (Schenk, et al., 2018). So, the EMR allowed nurses to spend more time in a patient's room, however some of the nursing time previously spent on education and face-to-face interaction is now taken up by documentation within the system. While this article did not point to any clear clinical outcomes, positive or negative, it does represent a concerning shift in nursing focus and attention while interacting with patients. Further, nurses have reported practicing risky behavior with patient care and documentation when technology negatively impacts their work setting (Draus, Bromall, & Mishra, 2018). However, there is counter literature published that confirms quality of patient care is positively impacted by nurses through successful adoption of evidence-based practice recommendation embedded within the EMR (Walker, 2016). One clear example of this is the increase in incentive spirometry noted by a hospital after the adoption of large electronic visibility boards that clearly identified when the incentive spirometry task was due for nursing and unlicensed assistive personnel (Field, Fong, & Shade, 2018).

The category, quality of care, possess the most conflicting literature as compared to the other categories of design, acceptance, and implementation. This is likely attributed to the wide variety of care settings in which EMRs are used, as well as each care settings' organizational culture. For those organizations that have strong clinical practice rooted in evidence-based care, application of this practice model within EMRs seems to have clear impacts. However, for organizations that lack centralized practice oversight, the EMR tool may further perpetuate this practice and evidence-based gap. It is clear from the literature that EMRs possess the possibility of being a strong clinical tool, however this possibility is not realized in every care setting.

NURSING SATISFACTION WITH THE EMR

Implementation & Evaluation

While implementation of the EMR is a momentous project milestone, the ongoing evaluation of the EMR is likely more impactful to end users over the long term. Evaluation of an EMR shortly after implementation is necessary as it may inform ongoing organizational decision making (Bossen, Jensen, & Udsen, 2013). In addition, social influence may have the largest impact on nurses' intention to use the EMR system long term (Holtz & Krein, 2011). In this context, social influence refers to the overall morale and social interactions among nursing staff (Holtz & Krein, 2011). These two articles represent key takeaways: evaluation is an important step to help guide organizational decision making, however local leaders must pay careful attention to the social makeup on their care areas, as that may play the biggest role in ongoing acceptance and evaluation of the EMR. To put it more clearly, nursing leaders play a large role in ensuring their care areas have a social setting, or morale, conducive to accepting the new EMR. While these two takeaways are beneficial, there is a literature gap related to evidence-based tools for EMR evaluation from the nursing perspective.

Nursing Perspective

The nursing perspective as it relates to EMR design, acceptance, quality of care, and implementation / evaluation is extremely valuable. However, as previously identified, there is only one tool currently known for evaluating nursing satisfaction with EMRs (Otieno, Toyama, Asonuma, Kanai-Pak, & Naitoh, 2007). This article is now 12 years old and was developed in Japan. While the questionnaire demonstrated reliability and validity, it has not been utilized longitudinally in the United States. A useful exercise would be to disseminate this questionnaire at defined points in time to evaluate the tool's predictive validity. This tool could be applied in a widespread clinical context: inpatient, outpatient, and peri-operative nursing care areas to help

NURSING SATISFACTION WITH THE EMR

inform design, acceptance, quality of care, and evaluation of EMRs. One could argue that the nursing profession spends as much time interfacing with the EMR as it does patients; this is a startling realization meant to inspire the importance of evaluating EMRs.

Management Strategies

The first step to evaluating nursing satisfaction with EMRs is generating an industry accepted evaluation tool. While multidisciplinary evaluation tools may be helpful to an EMR vendor and at the organizational level, they do little to help the nursing profession ensure their needs are consistently met. Essentially, a multidisciplinary evaluation offers a 10,000-foot view of EMR acceptance but is not able to drill down to profession specific acceptance. The literature is clear: nursing impressions of the EMR directly impact the design, acceptance, patient outcomes, and implementation of the EMR. To validate an existing tool, one must first understand the two main information systems conceptual frameworks, as well as understand how nursing satisfaction is currently managed in healthcare settings.

DeLone and McLean Model of Information Systems. The DeLone and McLean model of information system effectiveness assumes that system quality, information quality, and service quality, individually and jointly, affect user satisfaction and use of information systems (DeLone & McLean, Information systems success revisited, 2002). When this model was first introduced in 1993 the intent was to synthesize prior research regarding information systems into a clear body of knowledge that could be used by future researchers (DeLone & McLean, The DeLone and McLean model of information system success: a ten-year update, 2003). This model seeks to establish a comprehensive understanding of the six most critical dimensions of information systems success (DeLone & McLean, Information systems success revisited, 2002). The six dimensions are: information quality, system quality, service quality, system use / usage

NURSING SATISFACTION WITH THE EMR

intentions, user satisfaction, and net system benefits (DeLone & McLean, Information systems success revisited, 2002). This model has been widely investigated and accepted within the information science literature (Otieno, Toyama, Asonuma, Kanai-Pak, & Naitoh, 2007). One of the benefits of this model is that it explains how each one of the critical dimensions are interrelated, see Figure 1. In addition, the simplicity of this tool allows readers to easily understand how one variable impacts the others. Reading the figure from left to right, the reader can see that the first evaluation starts with system quality and information quality, leads to use and user satisfaction impacts, and ultimately lands on individual and organizational impacts.

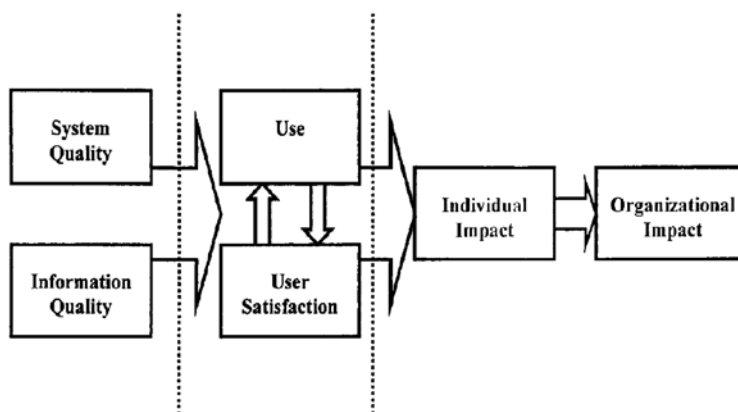


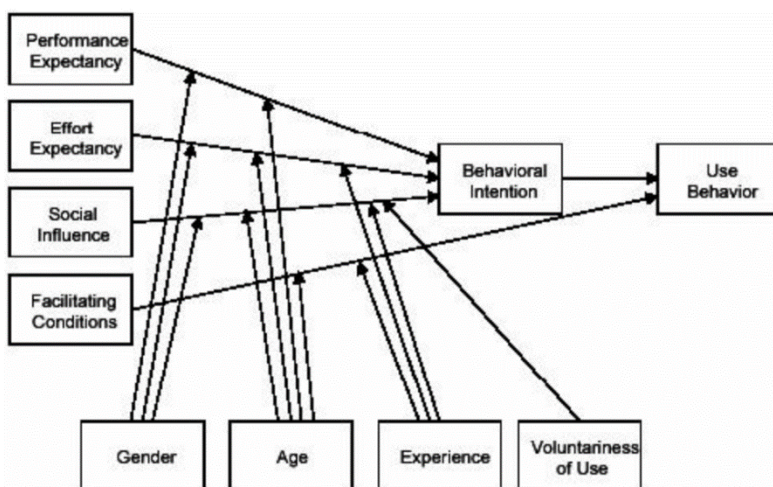
Figure 1. DeLone & McLean information science success model. Adapted from The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. (2003). *Journal of Management Information Systems*, 19(4), 9–30.

While this model is widely accepted within information science, there are no empirical studies using this conceptual framework amongst the medical informatics community (Otieno, Toyama, Asonuma, Kanai-Pak, & Naitoh, 2007). One approach would be to take DeLone & McLean's six dimensions of information systems successes and apply them to the EMR evaluation categories of design, acceptance, quality of care, and information / evaluation. This

NURSING SATISFACTION WITH THE EMR

combination may allow nursing researchers to apply the DeLone & McLean model of information systems to the nursing informatics model of EMR evaluation successfully in an interrelated way.

Unified Theory of Acceptance and Use of Technology. The Unified Theory of Acceptance and Use Technology (UTAUT) is a technology acceptance model that aims to evaluate user intentions of information systems and subsequent usage behavior (Venkatesh, Morris, Davis, & Davis, 2003). This model was introduced in 2003 after the authors conducted a thorough review of the 8 most prominently accepted models and collated these models into one unified model (Venkatesh, Morris, Davis, & Davis, 2003). UTAUT identifies four key constructs: performance expectancy, effort expectancy, social influences, and facilitating conditions (Venkatesh, Morris, Davis, & Davis, 2003), see Figure 2. Gender, age, experience, and voluntariness of use were found to impact the 4 key constructs (Venkatesh, Morris, Davis, & Davis, 2003). At first glance, this model appears more visually complex, however simple observation indicates how each variable ultimately impacts the end user's behavior intention and overall use behavior.



NURSING SATISFACTION WITH THE EMR

Figure 2. Unified theory of acceptance and use of technology schematic. Adapted from Venkatesh, V.; Morris, M.;Davis,G.;Davis, F, “User acceptance of information technology: Toward a unified view”, MIS Quarterly, 2003, 27, 3, 425-478.

The UTAUT adds the additional constructs of gender, age, experience, and voluntariness of use to the model, whereas the DeLone and McLean model does not take these variables into account. This is an interesting point of consideration, as the medical literature identified that user age, place of work, and prior EMR use directly impact the acceptance of a system (de Veer & Francke, 2010). While neither of these tools were developed specifically for the evaluation of medical information systems, the UTAUT model seems to include a more comprehensive evaluation of constructs that may impact EMR use and resultant success by nursing staff. In addition, the DeLone & McLean model identifies how system outcomes roll up to the organizational level, whereas the UTATU model terminates at individual use behavior. It may be assumed in the UTATU model that individual use behavior impacts organizational behavior, however this is not clearly explained in the model.

Administrative Management. There is no industry standard for evaluating nursing satisfaction with EMRs, or for validating best practices around quality care metrics impacted by EMRs. Due to the lack of evaluation tools and industry oversight, management of EMRs varies by organizations. Currently, many nursing leaders are asked to monitor nursing performance metrics such as barcode scanning compliance, overdue task occurrence, and comprehensive documentation rates. This is both a retrospective and reactionary approach and does not encourage optimization of EMRs in the moment. While this approach would curtail the positive deviance trend identified by Bristol, Nibbelink, Gephart, & Carrington (2018), it does not encourage upstream problem solving. Perhaps many of these positive deviance behaviors could

NURSING SATISFACTION WITH THE EMR

be prevented by a robust design phase, which would produce an EMR that matches clinical nurses' workflow. Overall, there is no current proactive administrative management of nursing satisfaction with EMRs.

Synthesis

There are two directions possible for addressing nursing satisfaction with EMRs: 1) apply and review Otieno's questionnaire, or 2) develop a new questionnaire and evaluation process utilizing either the DeLone & McLean or UTAUT conceptual frameworks. Ultimately, either approach would prove a useful endeavor, and would likely generate substantial information for the nursing and medical informatics communities. In addition, both approaches would align nicely with the 4 categories of published literature: design, acceptance, quality of care, and implementation / evaluation. However, Otieno's questionnaire has already been shown to demonstrate reliability and validity, making use of this approach initially more feasible. This approach also allows for longitudinal application, which offers the potential for further evaluation of different types of validity. Overall, the most practical initial approach appears to be further refinement of Otieno's tool, with a longitudinal application. The development of a realistic tool to measure nursing satisfaction with EMRs may contribute direct and meaningful impacts to the design of EMRs, ultimately improving nursing satisfaction, organizational efficiencies, and the quality of care received by patients.

Based on the review of literature and conceptual frameworks, the ideal next step would be implementing Otieno's questionnaire to evaluate nurses' views on the use, quality, and user satisfactions with EMRs. EMR use will continue to increase over time and will require continuous revisions and optimization phases. This provides the nursing profession with an ideal position to evaluate and advocate for the unique needs of nursing as it relates to EMRs. The

NURSING SATISFACTION WITH THE EMR

needs of the nursing profession could then be meaningfully applied to EMR updates, with the realistic outcome of increasing the quality and efficiency of care delivery. Any recommended optimizations would likely positively impact the 4 areas of design, acceptance, quality of care, and implementation / evaluation. Once an evaluation tool is clearly identified, future studies could compare and contrast EMR vendors as they relate to nursing satisfaction, implementation variances by site of clinical care, and training impacts on EMR go-lives, to name a few. The options for nursing evaluation of EMRs would be limitless once a standard tool is widely accepted.

Critique

The current literature fails to identify an industry standard for systematically evaluating nursing satisfaction with the EMR. This literature gap will continue to fail to meet the needs of evidence based EMR design, implementation, and optimization. The literature gap will also prevent industry best-of-breed solutions for nursing documentation needs with the EMR. In addition, much of the literature focuses on provider use and satisfaction, which does not fully encompass the needs of the advance practice nurse. The absence of peer reviewed literature in this domain prevents healthcare organizations from systematically approaching nursing satisfaction with the EMR.

Conceptual Framework

As previously established in the literature review, there are three widely documented information technology conceptual frameworks; this project adopted the DeLone & McLean information sciences success model. This framework allows for easy comprehension of how system, information, and service quality all interact to impact overall user and organizational

NURSING SATISFACTION WITH THE EMR

satisfaction. In addition, this conceptual framework was also selected for use in Otieno's instrument development.

One of the greatest assets of this tool is the clear definition of the discrete domains that ultimately impact user and organizational satisfaction: information quality, system quality, and service quality. These domains become particularly beneficial when developing or testing an information technology satisfaction instrument. The combination of this framework with Otieno's instrument and selected demographics will result in data that supports the overall project aims

Methodology

The methods of this project are designed to directly support the three aims. The three aims of this study are: 1) describe nursing use, quality, and satisfaction with the EMR before and during the course of EMR transition; 2) examine differences between nurse age, role, and area of work with nursing use, quality, and satisfaction; and 3) examine internal consistency of the instrument.

Project Type & Design

The design of this study is an analytic observational cohort study. The inclusion criteria varies slightly based on the individual study aims, however, overall, the baseline use, quality, and satisfaction survey includes all nurses at SCH, while the post-implementation survey will only include the nurses directly involved in the EMR design. Data collection will occur in September 2019 and March 2020. The project design has been reviewed and endorsed by the Director of Nursing Informatics, Director of Information Technology, and Senior Director of

NURSING SATISFACTION WITH THE EMR

Nursing Research at SCH. SCH's Internal Review Board has deemed this a Quality Improvement initiative, therefore this study was granted an exempt status.

Implementation Setting

This study took place at SCH's main campus in Laurelhurst, Seattle. While survey participation is open to all SCH nurses, which includes all regional sites across a four-state region, the intervention occurred at the main campus. The defined intervention site is secondary to informatics analyst resource location.

Participants & Recruitment

Survey participants were recruited and identified through their presence on the SCH nursing email distribution list. While overall numbers of nurses vary slightly, most recent data indicates there are just under 1,900 nurses on staff (Seattle Children's Hospital, 2019).

Participants were recruited via email and in person at a variety of nursing shared governance council meetings. A flyer containing a QR code, see Appendix, was disseminated broadly to all nurses. There were 297 survey respondents for the survey sent in September 2019, with 60 of those self-identified as subject matter experts (SMEs). Post-data collection in March 2020 resulted in 11 SME respondents. The respondents represented a diverse group of nurses from across the organization: inpatient, outpatient, perioperative, emergency, and critical care were a few of the clinical areas represented in the respondent group.

Intervention

The study intervention, nursing led EMR design, was carried out by approximately 60 nursing EMR SMEs. To become a SME, a nurse self-communicated interest to the nursing informatics team and was then approved by his/her direct manager.

NURSING SATISFACTION WITH THE EMR

The nursing SMEs met weekly on Tuesdays for an eight-hour design day. Their work included meeting with analysts to make design, workflow, and policy recommendations that align with the current and future nursing role SCH. The SMEs also reviewed and validated analyst build to ensure it met the original specifications. These design sessions were led by members of the nursing informatics team. The weekly meeting cadence occurs between April 2019 – March 2020.

Data Collection

Data collection occurred in a software program called Research electronic data capture (REDCap). REDCap is a web-based software program developed to provide biomedical research teams tools for collecting, storing, and disseminating clinical and translational research data (Harris, et al., 2009). This program allows for secure survey build, distribution, and data collection as well as response fidelity. This tool was selected for use as it is offered and supported by SCH.

The data collected relates directly to the three stated aims. The survey contains questions across four domains: respondent demographics, nursing EMR use, nursing EMR quality, and nursing EMR satisfaction. The survey response data directly informed the first three aims of this study.

There were two data collection points: September 2019 and March 2020. Survey distribution differed slightly as the first collection point, September 2019, included all nurses at SCH while the second collection point was targeted only to nursing SMEs.

NURSING SATISFACTION WITH THE EMR

Measurement

Otieno's nursing use, quality, and satisfaction survey was selected as the study instrument. This instrument includes 34 Likert scale questions (1 = *strongly disagree* to 5 = *strongly agree*) that are grouped into three constructs: use, quality, and satisfaction with the EMR (Appendix A). The *use* and *quality* constructs contain 12 questions, whereas the *satisfaction* construct contains 9 questions.

The instrument was created in 2007 in Japanese hospitals (Otieno, Toyama, Asonuma, Kanai-Pak, & Naitoh, 2007). Instrument validity was evaluated through the individual criterion validity analysis published in the Journal of Advanced Nursing, as well as through face validity performed by nursing and informatics stakeholders at SCH. The instrument developers note that the instrument cannot be considered fully validated due to reliability scores falling below applied research standards and a small sample size (Otieno, Toyama, Asonuma, Kanai-Pak, & Naitoh, 2007). However, the research team and SCH stakeholders still assume utility in selecting this instrument.

This tool was selected for ease of distribution, ability to add demographics, as well as face validity review by key SCH stakeholders. It was determined there is utility in specifically measuring the three distinct constructs: use, quality, and satisfaction, as this may allow for a more robust EMR evaluation. In addition, this instrument aligns well with the theoretical framework selected for this study.

Data Analysis

The data were abstracted from REDCap, entered into a data base (Base SAS 9.4), and screened for missing data and outliers. All cases with missing data and outliers were noted.

NURSING SATISFACTION WITH THE EMR

Data was further cleaned by reverse scoring the question “Is the system subject to frequent system problems and crashes”. Analysis for aims 1-3 was then completed.

Aims 1 & 2

Demographic and survey items were summarized for each cohort. To analyze aims 1 and 2 a descriptive statistical analysis was performed. Categorical variables were summarized using frequencies and percentages. A Fisher’s Exact test was conducted.

Aim 3

A total score Cronbach’s alpha was calculated to assess internal consistency of the Nursing Use, Quality and Satisfaction instrument. A threshold of 0.70 is used to signify acceptable internal consistency and a level of about 0.9 can suggest redundancies in the tool (Tavakol & Dennick, 2011). This will be calculated in SAS through obtaining covariances.

Results

The majority of respondents at the pre data point were from the 25-39 years old age group, practice in the ambulatory nurse role, and have been tenured at SCH for more than 11 years (Table 1). At the post data point, the majority of respondents were from the 25-39 years old age group, practice as inpatient bedside nurses, and have been tenured at SCH for more than 11 years (Table 1).

NURSING SATISFACTION WITH THE EMR

Table 1

Demographic classification of subject matter expert nurses pre and post intervention.

Characteristic	Pre (N=60) N (%)	Post (N=11) N (%)
Age, Years		
18-24	3 (4.2)	0 (0)
25-39	28 (39.4)	7 (9.9)
40-59	22 (30.9)	4 (5.6)
60+	7 (9.9)	0 (0)
Primary Role		
Bedside nurse	15 (21.1)	7 (9.9)
Charge nurse	10 (14.1)	3 (4.2)
Care coordinator	2 (2.8)	0 (0)
Ambulatory nurse	16 (22.5)	0 (0)
Other	12 (16.9)	1 (1.4)
Tenure at Children's, Years		
Less than 2	7 (10)	0 (0)
2-5	12 (18.6)	2 (2.8)
6-10	8 (11.4)	3 (4.3)
11+	32 (45.7)	5 (7.1)
Tenure at Children's in Current Role, Years		
Less than 2	12 (16.9)	1 (1.4)
2-5	22 (30.9)	1 (1.4)
6-10	13 (18.3)	7 (9.8)
11+	13 (18.3)	2 (2.8)
Clinical Area		
Inpatient-acute care	12 (16.9)	4 (5.6)
Inpatient-critical care	6 (8.5)	1 (1.4)
Periop/OR/PACU	3 (4.2)	2 (2.8)
Radiology	1 (1.4)	0 (0)
ED/Urgent Care	5 (7.0)	3 (4.2)
Ambulatory	29 (40.8)	0 (0)
Other	4 (5.6)	1 (1.4)

Aim 1

The first aim was to describe nursing use, quality, and satisfaction with the EMR before and during the course of the EMR transition. The mean response for each information technology sub scale increased after the intervention (Table 2). This aim compared responses

NURSING SATISFACTION WITH THE EMR

specifically from nursing SMEs pre and post the intervention. Full data for each sub-scale is available in Appendix C.

Table 2

Mean and standard deviation results for instrument defined sub-scales pre and post nursing design intervention.

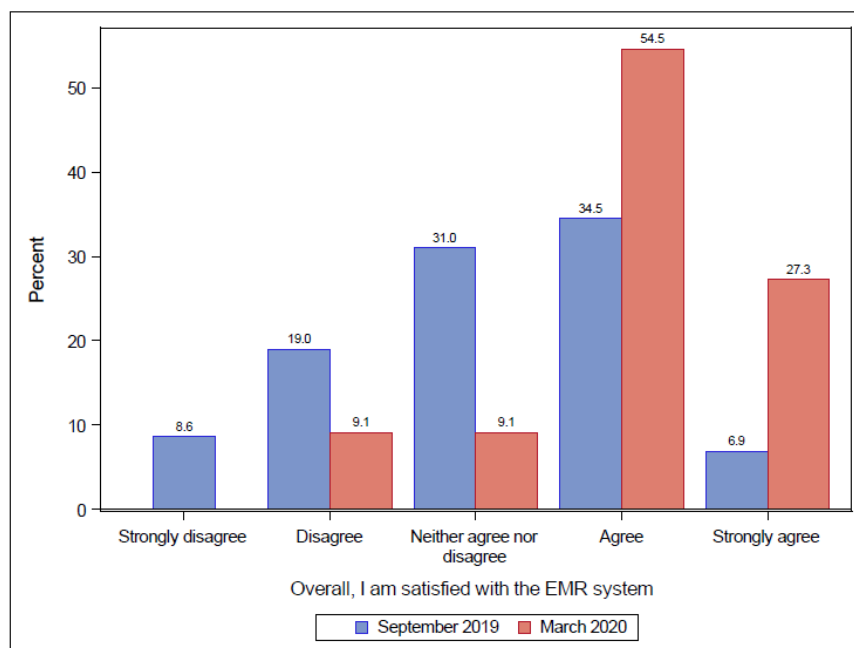
Sub- Scale	Pre N With Data	Pre Mean (SD)	Post N With Data	Post Mean (SD)
Nurse Management Subscale Score, Mean (SD)	57	2.76 (0.86)	11	3.52 (0.54)
Frequency of Use Subscale Score, Mean (SD)	57	3.77 (1.12)	11	4.22 (0.91)
Information Quality Subscale Score, Mean (SD)	55	3.27 (0.50)	10	3.67 (0.53)
Service Quality Subscale Score, Mean (SD)	58	3.34 (0.56)	11	3.41 (0.66)
EMR System Impact on Clinical Care Subscale Score, Mean (SD)	55	3.44 (0.73)	11	4.08 (0.64)

The responses for the final question on the instrument, “Overall, I am satisfied with the EMR system”, showed an increase in mean response from 3 in the pre group to 4 in the post group (see Figure 3) ($p = 0.1165$), a $p < 0.05$ is considered significant.

NURSING SATISFACTION WITH THE EMR

Figure 3

A graph comparing pre and post survey response to the question “Overall, I am satisfied with the EMR system”.



Aim 2

The second aim examined differences between nurse respondent age, role, and area of work with nursing use, quality and satisfaction. The nursing role reporting the highest satisfaction was nursing care coordinators (3.9 ± 0.9). Acute care RNs reported the highest satisfied clinical area (3.8 ± 0.9). The highest satisfied age range was 60+ (3.6 ± 0.9). Overall, the highest satisfied tenure range occurred between 6-10 years (3.7 ± 1.0) (Table 3).

NURSING SATISFACTION WITH THE EMR

Table 3

Mean and standard deviation responses by demographic category.

	Nurse Management Subscale	Frequency of use of order entry subscale	Information quality subscale	Service Quality Subscale	EMR System impact on clinical care	Overall, I am satisfied with the EMR system
Age, Years						
18-24	3.3 (1.0)	3.8 (1.3)	3.5 (0.5)	3.5 (0.5)	3.5 (0.5)	3.5 (0.8)
25-39	3.2 (0.9)	3.9 (1.0)	3.4 (0.5)	3.5 (0.6)	3.6 (0.7)	3.5 (1.1)
40-59	2.8 (0.8)	3.8 (1.0)	3.5 (0.5)	3.4 (0.6)	3.7 (0.8)	3.4 (1.0)
60+	2.9 (1.1)	3.8 (0.9)	3.6 (0.5)	3.5 (0.5)	3.8 (0.6)	3.6 (0.9)
Primary Role						
Bedside nurse	3.7 (0.6)	4.2 (0.7)	3.5 (0.6)	3.5 (0.6)	3.6 (0.7)	3.4 (1.1)
Charge nurse	3.3 (0.6)	4.2 (0.6)	3.5 (0.5)	3.3 (0.6)	3.8 (0.7)	3.5 (1.0)
Care coordinator	2.4 (0.6)	3.6 (1.1)	3.5 (0.7)	3.4 (0.8)	3.8 (0.8)	3.9 (0.9)
Ambulatory nurse	2.5 (0.7)	4.0 (0.8)	3.3 (0.5)	3.5 (0.5)	3.6 (0.8)	3.2 (1.0)
Other	2.3 (0.7)	3.0 (1.3)	3.4 (0.4)	3.7 (0.5)	3.6 (0.6)	3.6 (0.8)
MA, Nurse Tech	2.1 (0.6)	2.6 (1.0)	3.5 (0.6)	3.4 (0.5)	4.0 (0.7)	3.9 (1.0)
Tenure at Children's, Years						
Less than 2	3.3 (1.0)	3.9 (1.1)	3.4 (0.5)	3.6 (0.6)	3.4 (0.7)	3.3 (1.1)
2-5	3.0 (0.8)	3.9 (1.0)	3.3 (0.6)	3.5 (0.5)	3.5 (0.7)	3.3 (1.0)
6-10	3.2 (0.9)	3.9 (1.0)	3.6 (0.6)	3.5 (0.6)	3.9 (0.8)	3.7 (1.0)
11+	3.0 (0.9)	3.9 (0.9)	3.5 (0.5)	3.4 (0.5)	3.8 (0.7)	3.5 (1.0)
Tenure at Children's in Current Role						
Less than 2	3.2 (1.0)	3.7 (1.1)	3.4 (0.5)	3.6 (0.5)	3.6 (0.7)	3.3 (1.1)
2-5	3.1 (0.9)	4.0 (0.9)	3.4 (0.5)	3.4 (0.6)	3.7 (0.7)	3.4 (1.0)
6-10	3.1 (0.9)	3.9 (0.9)	3.5 (0.5)	3.4 (0.5)	3.9 (0.8)	3.8 (0.9)
11+	3.1 (0.9)	3.8 (0.9)	3.6 (0.6)	3.4 (0.6)	3.7 (0.7)	3.6 (0.9)
Clinical Area						
Inpatient-acute care	3.6 (0.8)	3.9 (1.0)	3.6 (0.6)	3.6 (0.5)	3.9 (0.7)	3.8 (0.9)
Inpatient-critical care	3.6 (0.6)	4.5 (0.6)	3.4 (0.4)	3.5 (0.6)	3.3 (0.7)	2.9 (0.9)
Periop/OR/PACU	3.2 (0.5)	3.6 (1.2)	3.8 (0.7)	3.4 (0.5)	4.1 (0.8)	3.9 (1.2)
Radiology	2.9 (0.5)	3.6 (1.2)	3.1 (0.4)	3.3 (0.4)	2.8 (0.6)	2.2 (0.8)
ED/Urgent Care	3.4 (0.5)	3.9 (0.9)	3.2 (0.3)	3.1 (0.5)	3.4 (0.6)	3.1 (0.7)
Ambulatory	2.4 (0.7)	3.8 (1.0)	3.4 (0.5)	3.5 (0.6)	3.7 (0.8)	3.4 (1.1)
Other	2.7 (0.9)	3.5 (1.0)	3.5 (0.5)	3.4 (0.5)	3.6 (0.6)	3.5 (0.9)

NURSING SATISFACTION WITH THE EMR

Aim 3

This instrument demonstrated internal consistency, Cronbach's Alpha = 0.89. This was calculated in SAS through comparing covariances of the instrument responses; this is defined as the squared correlation between the observed value and the true value. Overall, this evaluated the proportion of the variance in responses due to true differences as opposed to measurement error.

Discussion

Demographic Differences

Having discrete data that identifies nursing use, quality, and satisfaction scores by nursing role, clinical area, tenure, and age is extremely valuable. This allows nursing informatics departments to create targeted interventions including re-training and system enhancements that could better meet end user needs. In fact, the literature supports evaluation of the EMR as a way to inform ongoing organizational decision making (Bossen, Jensen, & Udsen, 2013), so adopting a standardized evaluation tool that includes demographic data allows for further targeting of organizational interventions. Organizations could experience a significant cost savings by offering targeted interventions based on varying satisfaction levels. This may support EMR design that ultimately matches nursing workflow. EMRs that support nursing workflow may help prevent positive deviance, the phenomenon of nurses actively working around the EMR when the system does not match their needs (Bristol, Nibbelink, Gephart, & Carrington, 2018). This survey combined with nursing demographics could help identify areas of opportunity for reducing positive deviance, increasing nursing satisfaction, and decreasing organizational optimization costs.

NURSING SATISFACTION WITH THE EMR

Exposure to Nursing Informatics

The recorded means and standard deviations in the pre and post groups, see Table 2, indicate that nurses had a more positive response to their overall satisfaction with the EMR after participating 11 months of weekly nursing led EMR design sessions. This response is particularly interesting as post data was collected before the new EMR system was live. While the Fisher's Exact Test did not support a statistically significant finding, observational opportunities still exist.

The exposure of the SME nurses to the field of nursing informatics cannot be undervalued. Increased bedside nurse understanding of nursing informatics can only support ongoing EMR opportunities, in addition to individual nursing professional development opportunities. At times front-line nurses make recommendations or assumptions about the EMR that represent a lack of full understanding of the EMR system constraints. Exposure of the EMR design process to nurses can only help front-line understanding of design decisions as well as inform future EMR decisions.

Another organizational opportunity exists in having the SME nurses lead the change management that goes along with any EMR implementation. Change management often happens most effectively 1:1 amongst front line staff members. Encouraging participation of front-line staff members in this project allows them the opportunity to champion change management at the unit level. Their existing rapport with their peers can be leveraged to support a more successful implementation. Social influence may have the biggest impact on a successful implementation (Holtz & Krein, 2011). The SME RNs may be able to leverage their social influence to help support the overall implementation.

NURSING SATISFACTION WITH THE EMR

Usefulness in an American Hospital

This instrument should be considered extremely valuable in American hospitals. The internal consistency combined with the satisfaction data stratified by demographics is extremely valuable to any healthcare organization. This instrument represents an ideal starting place for organizations to formally evaluate their nursing satisfaction using the DeLeone & McLean conceptual framework as a way to establish a national nursing satisfaction baseline. This would allow organizations that utilize the same EMR to benchmark against each other.

Perhaps the greatest opportunity lies in embedding best practice guidelines within the EMR. Patient care is positively impacted by incorporating evidence-based guidelines in the EMR design (Walker, 2016). The current state for healthcare organizations is that each organization purchases an out-of-the-box product from EMR vendors in isolation, and then tailors that product to meet their individual needs. The ability of each organization to thoughtfully incorporate evidence-based-guidelines likely varies based on organizational bandwidth, institutional knowledge, and overall informatics engagement levels. A standard evaluation tool would help identify those organizations that have developed a best-in-breed evidence-based nursing module and support application of these across American hospitals.

The most useful exercise likely lies in the nursing informatics community adopting one standardized instrument that can be disseminated across America. This would provide the field of nursing informatics a robust amount of data to create standard operating procedures for organization that are designing, implementing, and maintaining EMRs. The lack of industry standards currently does not support the patient's expectation of having technology solutions that support their current medical and cultural care needs.

NURSING SATISFACTION WITH THE EMR

Limitations

Changes to the implementation timeline and sample size represent the greatest limitations to this study design. The baseline data collection (September 2019) was an ideal data collection point, however the post collection point (March 2020) did not align with the over EMR implementation timeline. Originally, the ERM was slated to go live in May 2020, however, secondary to the novel Coronavirus, the implementation was pushed back to October 2020. This means that the post collection data likely does not truly represent post data, but rather an additional evaluation of the overall nursing satisfaction with the current EMR. In addition, there were some discrepancies in the pre and post nursing SME response rate. The pre response group represented approximately 60 nursing SMEs, while the post response only included 11 nursing SMEs. Once again, this is likely secondary to the mandated social distancing from the novel Coronavirus as the design sessions were forced to end prematurely.

Recommendation & Implications

The demographic data presented indicates that further intervention is required for those nurses in the 40-59 age range, the bedside nursing role, and the clinical areas of radiology and critical care. These demographic areas at SCH could benefit from targeted training and optimization, particularly focused on design aspects with the new EMR.

Future studies should look at the overall reliability and validity of the instrument itself. A useful exercise would be to disseminate this instrument across a larger health network to allow for a true evaluation of reliability and validation in addition to ANOVA studies. In addition, a longitudinal evaluation of nursing satisfaction in an organization could provide useful

NURSING SATISFACTION WITH THE EMR

information about sustained nursing satisfaction amongst system enhancements, upgrades, and new practices.

Conclusion

Nursing satisfaction with the EMR remains a real opportunity for health systems across America. Current literature focuses on provider satisfaction, but very little literature meaningfully looks at nursing satisfaction from a systems level. Organizations could save organizational time, improve patient outcomes, and increase nursing satisfaction through focusing on targeted interventions based on demographic satisfaction levels. This would further support the importance and value of the field of nursing satisfaction as a valued nursing domain. As the nursing students enter the workforce it will become critical for advance practice nurses to help foster environments that support the technological success of these future nurses.

NURSING SATISFACTION WITH THE EMR

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NURSING SATISFACTION WITH THE EMR

Appendix A

NURSING
SATISFACTION
WITH OUR
ELECTRONIC
HEALTH
RECORD

SEPTEMBER 2019 SURVEY

Please take 5 minutes
to fill out an
anonymous survey
about your current
satisfaction with CIS.
We are hoping to
measure any changes
post Epic – so we
need a baseline!

**This is a great
chance to let your
voice be heard!**

Link:
<http://j.mp/2YTU1F6>

A copy of the survey distribution flyer.

NURSING SATISFACTION WITH THE EMR

Appendix B

Confidential

Page 1 of 4

Nursing Satisfaction With the Electronic Health Record

Thank you for participating in this short survey measuring nurses impressions of the current electronic health record ("CIS" or "Cerner"). This survey will take about 5 minutes to complete; the information gathered will be used to understand SCH's nursing needs for our new electronic health record. Please know all of your answers are anonymous, and your participation is voluntary. Your identity cannot be connected to your responses Thank you!

Demographics	
What is your age?	<input type="radio"/> 18 - 24 <input type="radio"/> 25 - 39 <input type="radio"/> 40 - 59 <input type="radio"/> 60 plus
What is your primary role?	<input type="radio"/> Bedside nurse <input type="radio"/> Charge nurse <input type="radio"/> Care coordinator <input type="radio"/> Ambulatory nurse <input type="radio"/> MA, Nurse Tech <input type="radio"/> Other (please describe)
Other: please describe	_____
In total, how long have you worked at Children's?	<input type="radio"/> Less than 2 years <input type="radio"/> 2 - 5 years <input type="radio"/> 6 - 10 years <input type="radio"/> 11+ years
How long have you worked at Children's in your current role?	<input type="radio"/> Less than 2 years <input type="radio"/> 2 - 5 years <input type="radio"/> 6 - 10 years <input type="radio"/> 11+ years
In what area do you work?	<input type="radio"/> Inpatient - acute care <input type="radio"/> Inpatient - critical care <input type="radio"/> Periop / OR / PACU <input type="radio"/> Radiology <input type="radio"/> ED/Urgent Care <input type="radio"/> Ambulatory <input type="radio"/> Other
Other: please describe	_____
Are you a designated Subject Matter Expert (SME) for your clinical area?	<input type="radio"/> Yes <input type="radio"/> No

NURSING SATISFACTION WITH THE EMR

Electronic Medical Record (EMR) Use: In your current clinical practice, how often do you use the electronic health record to:					
	Never	Rarely	Occasionally	Frequently	Very Frequently
Review the patient's problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enter daily nursing care notes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capture patient observations at the bedside	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write nursing care plans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write nursing care worksheets (caredex)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collect patient information for discharge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Document physical assessments of patients	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Obtain information on investigation or treatment procedures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Obtain the results from new tests or investigations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Obtain the results from past tests or investigations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Answer questions concerning general medical knowledge (concerning treatment, symptoms, complications etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Check drug information (such as allergy and interactions)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

EMR Quality: In your current practice, how often:					
	Never	Rarely	Sometimes	Very often	Always
Does the system provide the precise information you need	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Does the system provide reports that seem to be just exactly what you need	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Does the system provide sufficient information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is the system accurate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are you satisfied with the accuracy of the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you think the output is presented in a useful format	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is the information clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is the system user-friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you get the information you need in time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Does the system provide up-to-date information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Can you count on the system to be up and available?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is the system subject to frequent system problems and crashes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

User satisfaction:					
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I feel the EMR is useful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel my performance has improved due to the EMR	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the quality of my work has improved	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the EMR is worth the time and effort required to use it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the quality of information has improved due to the EMR	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the EMR has been successful in this hospital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the EMR is an important system for this hospital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the safety of patients has improved due to the EMR	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I am satisfied with the EMR system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please provide any additional thoughts or feedback

A copy of the survey instrument

NURSING SATISFACTION WITH THE EMR

Appendix C

Item	Pre N With Data	Pre Median (25th %tile-75th %tile)	Post N With Data	Post Median (25th %tile-75th %tile)
Review the patient's problems	60	5 (4-5)	11	5 (4-5)
Enter daily nursing care notes	60	3 (2-4.5)	11	2 (2-4)
Capture patient observations at the bedside	59	3 (1-4)	11	5 (4-5)
Write nursing care plans	58	1 (1-3)	11	2 (1-5)
Write nursing care worksheets (caredex)	59	1 (1-2)	11	1 (1-2)
Collect patient information for discharge	59	2 (1-4)	11	4 (3-5)
Document physical assessments of patients	59	4 (1-5)	11	5 (4-5)
<i>Nurse Management Subscale Score, Mean (SD)</i>	<i>57</i>	<i>2.76 (0.86)</i>	<i>11</i>	<i>3.52 (0.54)</i>

1=Never, 2=Rarely, 3=Occasionally, 4=Frequently, 5=Very Frequently

Item	Pre N With Data N = 6	Pre Median (25th %tile- 75th %tile)	Post N With Data	Post Median (25th %tile-75th %tile)
Obtain information on investigation or treatment procedures	60	3 (2-5)	11	4 (3-5)
Obtain the results from new tests or investigations	59	4 (3-5)	11	5 (4-5)
Obtain the results from past tests or investigations	59	4 (3-5)	11	4 (3-5)
Answer questions concerning general medical knowledge (concerning treatment, symptoms, complications etc.)	58	4 (4-5)	11	5 (4-5)

NURSING SATISFACTION WITH THE EMR

Check drug information (such as allergy and interactions)	57	4 (3-5)	11	5 (4-5)
<i>Frequency of Use Subscale Score, Mean (SD)</i>	57	3.77 (1.12)	11	4.22 (0.91)

1=Never, 2=Rarely, 3=Occasionally, 4=Frequently, 5=Very Frequently

Item	Pre N With Data	Pre Median (25th %tile-75th %tile)	Post N With Data	Post Median (25th %tile-75th %tile)
Does the system provide the precise information you need	58	4 (3-4)	11	4 (4-4)
Does the system provide reports that seem to be just exactly what you need	57	3 (2-4)	11	3 (3-4)
Does the system provide sufficient information	59	4 (3-4)	11	4 (3-4)
Is the system accurate	59	4 (3-4)	11	4 (4-4)
Are you satisfied with the accuracy of the system	59	4 (3-4)	11	4 (3-4)
Do you think the output is presented in a useful format	59	3 (2-4)	11	3 (3-4)
Is the information clear	58	3 (3-4)	11	4 (3-4)
Is the system user-friendly	59	3 (2-3)	11	3 (3-4)
Do you get the information you need in time	59	3 (3-4)	11	4 (3-4)
Does the system provide up-to-date information	58	3 (3-4)	11	4 (4-4)
<i>Information Quality Subscale Score, Mean (SD)</i>	55	3.27 (0.50)	10	3.67 (0.53)

1=Never, 2=Rarely, 3=Sometimes, 4=Very Often, 5=Always

NURSING SATISFACTION WITH THE EMR

Item	Pre N With Data	Pre Median (25th %tile- 75th %tile)	Post N With Data	Post Median (25th %tile-75th %tile)
Can you count on the system to be up and available?	58	4 (3-4)	11	4 (4-4)
Is the system subject to frequent system problems and crashes ¹	59	3 (3-3)	11	3 (2-4)
<i>Service Quality Subscale Score, Mean (SD)</i>	58	3.34 (0.56)	11	3.41 (0.66)

1=Never, 2=Rarely, 3=Sometimes, 4=Very Often, 5=Always

1. Reverse-scored, 1=Always, 2=Very Often, 3=Sometimes, 4=Rarely, 5=Never

Item	Pre N With Data	Pre Median (25th %tile- 75th %tile)	Post N With Data	Post Median (25th %tile-75th %tile)
I feel the EMR is useful	60	4 (3-4)	11	4 (4-5)
I feel my performance has improved due to the EMR	60	3 (3-4)	11	4 (3-4)
I feel the quality of my work has improved	59	3 (2-4)	11	4 (3-4)
I feel the EMR is worth the time and effort required to use it	58	4 (3-4)	11	4 (4-5)
I feel the quality of information has improved due to the EMR	59	3 (3-4)	11	4 (4-5)
I feel the EMR has been successful in this hospital	59	4 (3-4)	11	4 (4-5)
I feel the EMR is an important system for this hospital	58	4 (4-5)	11	5 (4-5)
I feel the safety of patients has improved due to the EMR	58	4 (3-4)	11	4 (4-5)

NURSING SATISFACTION WITH THE EMR

Overall, I am satisfied with the EMR system	58	3 (2-4)	11	4 (4-5)
<i>EMR System Impact on Clinical Care Subscale Score, Mean (SD)</i>	55	3.44 (0.73)	11	4.08 (0.64)

1=Strongly Disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly Agree

Sub-Scale data