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Statewide Study to Assess Nurses' Experiences With Meaningful Use–Based Electronic Health Records

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Nursing professionals are at the frontline of the health information technology revolution. The Texas Nurses Association and Texas Organization of Nurse Executives partnered to evaluate the changing health technology environment in Texas, in particular the nurses' satisfaction with the use of clinical information systems. A descriptive exploratory study using the Clinical Information System Implementation Evaluation Scale and a newly developed Demographic Survey and the Meaningful Use Maturity-Sensitive Index, with a narrative component, was conducted in 2014 and 2015. Nurses across Texas received an electronic invitation to participate in the survey, resulting in 1177 respondents. Exploratory factor analysis revealed that variables of the Meaningful Use Maturity-Sensitive Index and Clinical Information System Implementation Evaluation Scale show strong interrater reliability, with Cronbach's α scores of .889 and .881, respectively, and thereby inform the survey analysis, indicating and explaining variations in regional and institutional trends with respect to satisfaction. For example, the maturity of a clinical information system within an organization and age of the nurse significantly influence the probability of nurse satisfaction ($P < .05$). Qualitative analysis of nurses' narratives further explained the nurses' experiences. Recommendations for future research and educational were identified.

KEY WORDS: Clinical decision support, Electronic health records, Informatics, Meaning use, Nursing informatics competencies, Satisfaction, Usability, Workflow

The healthcare industry is undergoing a major transformation to establish an interoperable health information technology (HIT) infrastructure to connect the nation with electronic health records (EHRs) and health information exchanges (HIEs). This informatics revolution is affecting all aspects of the nursing profession.[1–3] With the passage of the Health Information Technology for Economic and Clinical Health Act in 2009,[3] the Texas Nurses Association (TNA) Board of Directors formed an advisory committee to evaluate the changing health technology environment and make recommendations to the TNA Board regarding steps needed to prepare Texas nurses for the rapid uptake of technology in healthcare settings required by this legislation. The TNA Board joined with the Texas Organization of Nurse Executives (TONE) to create a statewide partnership with nursing leaders to address the impact of HIT on nursing in the state of Texas. The TNA and TONE Boards formulated the TNA-TONE HIT Task Force. In 2014, this task force became an official joint committee of both Boards, with recognition of the importance of HIT to nursing practice and the importance of both organizations partnering to address nursing impact.

The TNA-TONE HIT committee was charged with examining how Texas nurses were affected by newly implemented EHRs across the state and to establish baseline measures of nurses' satisfaction to inform evidence-based improvement strategies. To accomplish this goal, a statewide study was initiated to evaluate the perceptions of nurses about their clinical information systems (CISs), defined as EHRs. The full intent of the study was to evaluate the nurses' perspectives related to satisfaction with the usability of the institutions' CIS used in patient care delivery across Texas. This information was intended to inform statewide efforts in Texas to improve the use of HIT for nurses and other associated stakeholders. The purpose of this article is to summarize the development of a statewide Texas HIT study, describe the methods used, report the results of the study, and outline the next steps for a statewide improvement effort to address Texas nurses' satisfaction with their EHRs.

BACKGROUND AND SIGNIFICANCE OF THE STUDY

The quality of healthcare and patient safety in the United States has become a national concern in recent years, motivated by the release of several Institute of Medicine (IOM) reports. The first IOM report noted that medical errors were a national public health problem.[4] The same report suggested that substantive improvements in information technology were necessary to support clinical and administrative decision making about healthcare systems. A common theme in all of the IOM reports is that broad safety

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and quality improvement efforts require the development of innovative, electronic health information systems.[4–6]

Healthcare organizations in Texas are in the process of adopting and integrating information systems to meet the requirements of the Office of the National Coordinator (ONC).[7] The goal is to move toward universal adoption of CISs, achieve meaningful use (MU) of EHRs, and establish interoperability through HIEs. With 73.2% of office-based physicians using a certified EHR system, HIEs could provide a significant improvement in communication between providers and hospitals. However, literature regarding the evaluation of the benefits that accrue from the adoption of EHRs for nursing appears limited. For example, in a search of the major electronic databases, the past 5 years yielded 44 articles using *electronic health record* as a key term and the word *nursing* in the title. None of the articles systematically addressed *satisfaction*.[8–10] Within Texas, there has been little effort to systematically evaluate the experience of nurses who use information technology.

The role of information technology is complex and dependent on the systems and processes in which it is embedded. Furthermore, health information systems implementation is confounded by human factors and barriers that impede user acceptance and use of the systems.[11–13] If end users believe that the technology is easy to use and is beneficial in supplying the information they need for decision-making purposes, adoption has a higher likelihood of success. If end users perceive there is no relative benefit of the new system compared with what had been available to them in the past, it is reasonable to assume that adoption will be resisted.[10,13]

Two theoretical models for the successful implementation of information systems were appraised. The DeLone and McLean Model of Information Systems Success used in a number of information system evaluation studies identified three dimensions important to systems success: system quality, information quality, and service quality.[14] These dimensions may be measured by user satisfaction, intention to use, and measurable net benefits of the system. The second model, Rogers' innovation diffusion theory, identified constructs about technology that influence adoption as well as aspects of the adopters and the adoption process.[15] In addition, the innovation diffusion theory considers organizational factors that influence technology adoption.[15,16]

Attributes of technological innovation that affect adoption of CISs, also known as EHRs include perceived relative advantages, compatibility, complexity, trial-ability, benefits realization, adaptability, risk, task performance improvement, and knowledge. Characteristics of individual adopters that influence the adoption of innovation include tolerance of ambiguity, intellectual ability, motivation, values, learning style, and organizational or social position.[15] Given the relative newness of the use of CISs, several instruments were considered. The Clinical Information System Implementation Evaluation Scale (CISIES), developed by Gugerty et al,[17] was one that assesses user satisfaction across organizations and reflects attributes of technological innovation. The instrument is sensitive to the adopter's characteristics across organizations in both formative and summative evaluations of CIS implementation. More details about the CISIES will follow.

Assessing end-user perceptions of specific aspects of system functionality, usability, and usefulness is essential to identify approaches that can be used to make strategic improvements in CIS adoption, implementation, and optimization of the system. The objective of the TNA/TONE HIT study was to inform a strategy that improves Texas nurses' satisfaction with their EHRs. To accomplish this goal, baseline measures of satisfaction were needed.

STUDY METHODS

The statewide multiorganization study was a descriptive and exploratory study to identify key issues with the current deployment of EHRs in the practice setting and to identify characteristics associated with satisfaction to inform improvements. To address this aim, several research questions directed the design of the study:

1. What is the relationship between health setting characteristics and the nurses' satisfaction with their EHRs?
2. What is the relationship between the nurses' characteristics and the nurses' satisfaction with their EHRs?
3. What is the relationship between CIS characteristics and the nurses' satisfaction with their EHRs?
4. What are the themes and subthemes that emerge from the narrative comments (qualitative data) by nurses about using their EHRs that may inform improvement strategies?

The study design was supported by multiple partners, including TNA, TONE, and the Texas Tech University Health Sciences Center School of Nursing (TTUHSC SON). The TTUHSC provided research oversight and the internal review board approval for the study. A research subgroup consisted of TNA-TONE HIT committee members working with two principal investigators to develop the study design, methods, data collection, and analysis processes.

Sampling and Survey Response

In this statewide study, nursing staff members, who are end users of a CIS, employed by Texas healthcare organizations, represent the study population, including RNs, APRNs, LVNs, and support staff such as nursing assistants. The target population was derived from a representative sampling of nurses employed in private, public, and federal acute care facilities and their associated ambulatory/episodic care and long-term care units, referred to collectively as the healthcare organization (HCO).

To determine sample size, an a priori power analysis was conducted to ensure 0.8 power and a Cronbach's α of .05. A small effect size revealed the need for 1092 respondents.[18] This sample size was deemed to provide adequate representation of descriptive statistics and statistical modeling using logistic regression to examine factors associated with predicting satisfaction.

The TNA/TONE online survey was deployed through an e-mail sent to staff nurses from the chief nurse officer of the HCO inviting voluntary and anonymous participation using a stratified sampling method. The survey was launched statewide on September 23, 2014. The initial sampling strategy yielded approximately 250 survey responses. An improved secondary sampling strategy utilized a snowball approach with distribution of the invitation to participate, the survey link, and communication of purpose through e-mails sent by TNA and TONE leadership to the membership of both organizations. This secondary strategy resulted in 1177 total survey responses. Final data analysis to inform the recommended strategies was reflective of comprehensive responses from 987 participants. Figure 1 demonstrates the volume increase from the initial launch in September 2014 and the revised sampling strategy that resulted in the total responses concluding in February 2015.

STUDY DESIGN AND INSTRUMENTATION

Two instruments were used to meet the study objectives. The first of the instruments was the Demographic Survey and EHR Meaningful Use Maturity-Sensitive Index (MUMSI) designed by McBride and Tietze with a group of content experts.[19] The second instrument was the CISIES designed by Gugerty et al.[17]

Demographic Survey

The TNA/TONE research subgroup members designed the Demographic Survey consisting of two sections. The first section was composed of questions descriptive of key characteristics of each participant such as practice setting, shift, and experience with computers. These characteristics were used to control for differences in respondents and their respective organizations. The second section of the Demographic Survey addressed the maturity of the organization's EHR with respect to federal guidelines for MU[20] and nursing use. Methods to adjust for the maturity of the EHR are important to fully understand the nurses' experiences, particularly given rapid deployment of EHRs to meet federal certification guidelines across the state. The Demographic Survey was used to explore the relationships between CISIES responses, the participant and institutional demographic characteristics such as practice setting, shift, experience with computers, and type of institution, while controlling for the maturity of the EHR in the institution.

Meaningful Use Maturity-Sensitive Index

The maturity of an EHR was defined as the level of sophistication of the nurse's knowledge and use of EHR in daily practice. The research subgroup explored various mechanisms to evaluate the maturity of the EHR in an institution. The subgroup decided to utilize the ONC's Stage 1 MU measures as the model for capturing different levels of functional status about the maturity of the EHR. This also reflected the status of MU maturity within the state of Texas at the time the study was initiated. Content validity of the MUMSI was established with a two-round Delphi method with quantitative instrument design strategies defined by Lynn.[21]

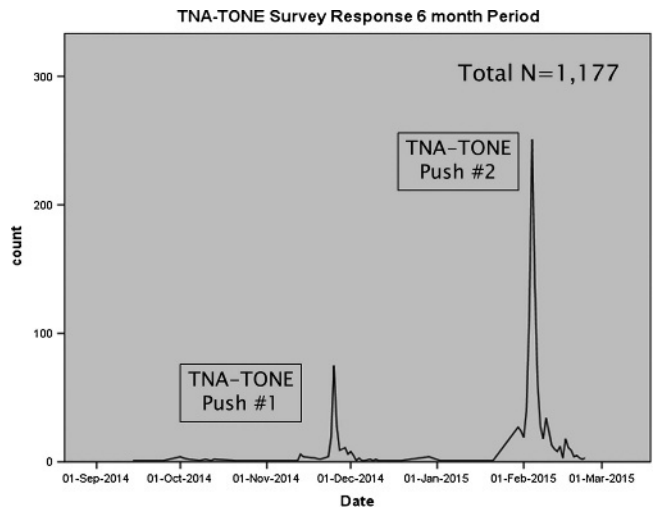

FIGURE 1. Study responses from a 6-month period from September 2014 through February 2015. Note: Two significant pushes for recruitment, #1 reflects original sampling strategy, #2 reflects snowball with distribution through TNA and TONE leadership.

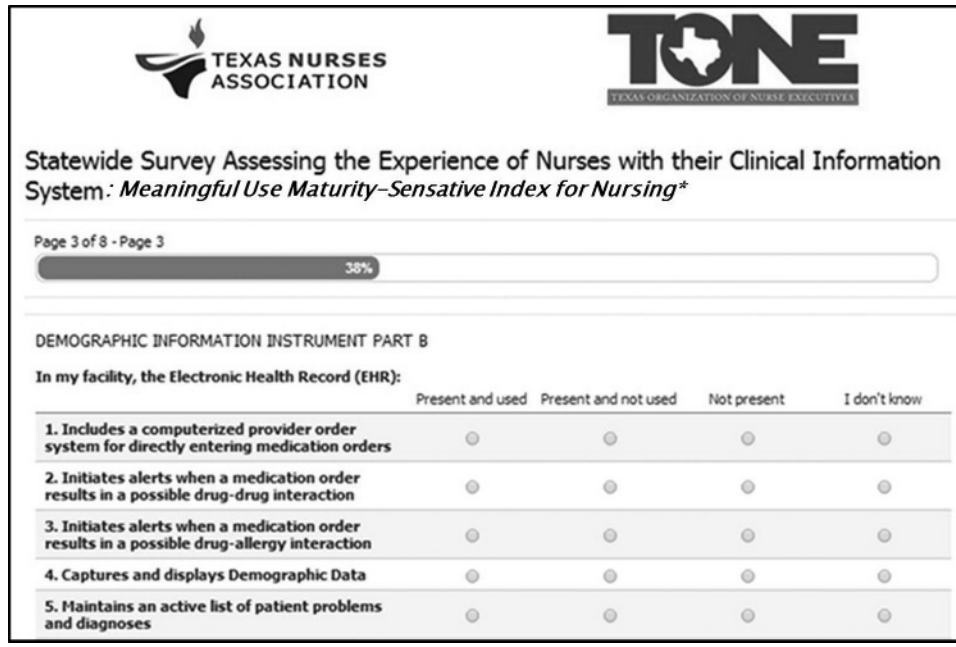

FIGURE 2. Sample questions from the MUMSI 24-scale instrument.

The MUMSI was deployed within the demographic information in the online survey. Figure 2 reflects a sample from the 24-item instrument and the manner in which the questions were presented to the participants. The participants were asked to indicate if the MU functionality was present and used, present and not used, not present, or they did not know if the functionality was present.

Clinical Information System Implementation Evaluation Scale

The CISIES is a 37-item survey designed to measure the participants' satisfaction with their CIS. The CISIES[17] uses response choices ranging from strongly agree to strongly disagree on a six-point Likert scale. The survey has been tested for reliability and validity and has a Cronbach's α ranging from .94 to .96.[17] In addition to achieving many of the study goals, the research subgroup determined that the CISIES provided the most robust data to inform academic and practice settings with plans needed to address HIT use by nurses.

Combined Instrumentation of Clinical Information System Implementation Evaluation Scale and Meaningful Use Maturity-Sensitive Index

Both the CISIES[17] and the MUMSI[19] yielded strong interrater reliability, with Cronbach's α scores of .881 and .889, respectively.[22] Nunnally et al[23] indicated that .7 to .8 was an acceptable α level. Additionally, the CISIES and MUMSI were examined using an exploratory factor analysis. The subscales identified within both the CISIES and the MUMSI can be used to detect further details that might inform improvement plans long-term. The initial examination was performed to assure the research subgroup that there was no immediate overlap in the variables explaining the CISIES and the MUMSI. Figure 3 reflects the performance of these two surveys when combined and analyzed using an exploratory factor analysis methodology. Note that the rectangles in Figure 3, although too difficult to interpret, represent each of the items on the two instruments (for further details of the factor analysis, contact the corresponding author). The research team draws the reader's attention to the patterns distinguished noting the cluster identified as MUMSI, CISIES, and clinical decision support (CDS).

Qualitative Narrative Content Analysis

An open-ended question related to nurses' experiences with the use of technology and EHRs in the clinical setting was included with the survey to gain in-depth textual information from the nurses beyond the constraints of the instruments utilized. The question was stated as "We are interested in your feedback and anything we might not have covered, please provide any additional information you care to provide." Of the 1177 surveys completed, 344 respondents provided free text or narrative responses. NVIVO[19] (QSR International, Doncaster, Victoria, Australia) was used to conduct a word frequency analysis. This analysis detected key terms that could be easily dropped back into the quantitative data. This result did not fully inform the improvement strategy, so further analysis of the qualitative data was needed. These narratives were analyzed and coded for themes by the research subgroup.

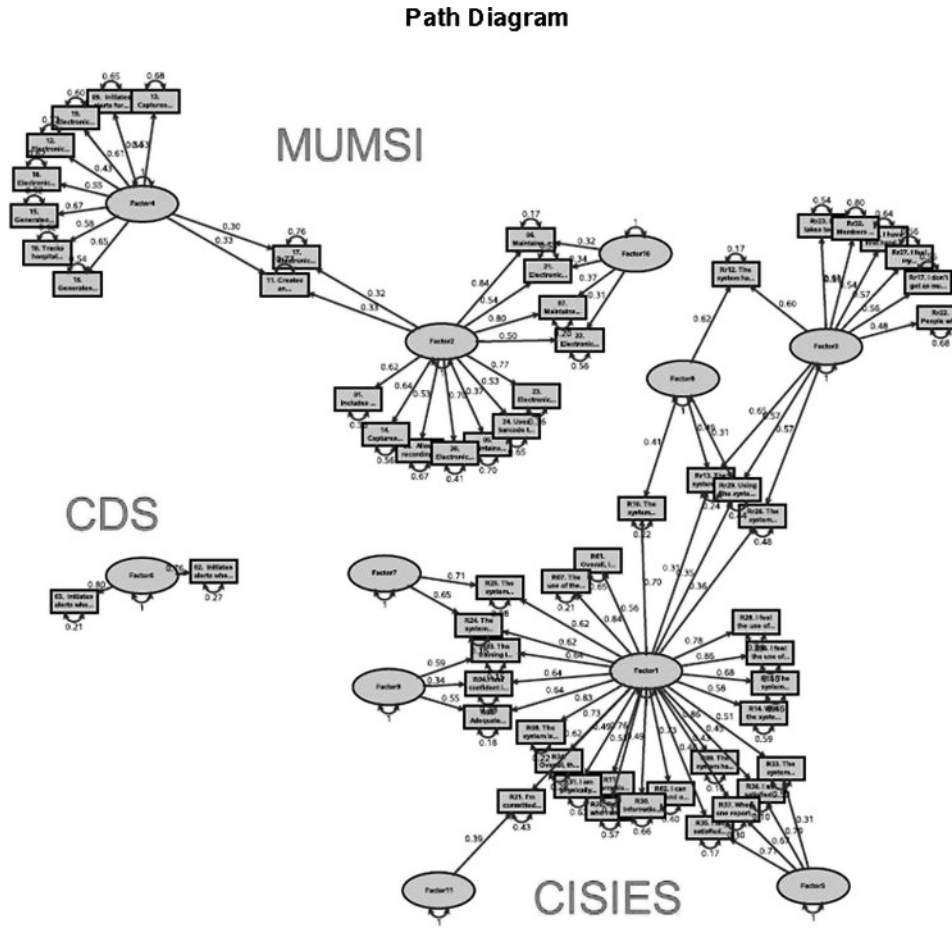

FIGURE 3. Exploratory factor analysis: CISIES and MUMSI. Note: Exploratory Factor Analysis of Significant clusters including Clinical Information Systems Implementation Evaluation Scale (CISIES) with subscales, Meaningful Use Maturity Sensitive Index (MUMSI) with subscales. Clinical Decision Support (CDS) is a significant subscale associated with dissatisfaction on drug-drug alerts and drug-allergy alerts.

The confidentiality of participants was maintained through use of an electronic survey administration system designed and deployed by TTUHSC SON Information Technology Department, which included a Secure Sockets Layer, a protocol that works through a cryptographic system that secures a connection between a client and a server. An off-the-shelf software was used to design the online survey including the demographic section, 24-item MUMSI, and 37-item CISIES questionnaires. No attempt was made to identify nurse respondents or their individual response data. The study received approvals for an exempt study by the TTUHSC institutional review board.

STUDY FINDINGS

Characteristics of the Study Population

Of the total 1177 respondents, 987 responded to all survey questions; of those respondents, 21.4% (n = 211) represented a rural setting and 78.5% (n = 772) an urban setting. Rural respondents practiced in acute care (57.4%), ambulatory care (10.9%), long-term care (0.5%), and other care areas (30.8%). Urban respondents practiced in acute care (55.2%), ambulatory care (12%), long-term care (1.4%), and other care areas (31.2%).

Overall, 68.3% of the respondents indicated that they provide direct patient care and 31.7% indicated that they do not provide direct care. Sixty-two percent (62.6%) identified their role as staff, 13.5% as a manager/director/supervisor, and 23.9% reported as other. Men represented 8.7% of the sample, and women, 91.3%. Race was predominantly white Caucasian at 83.6%, 5.6% Black/African American, and other at 10.8%. Of the respondents, 19.4% indicated years in nursing as fewer than 5 years, while 41% reported being in nursing for more than 20 years. The shift the nurse worked was reported as 74.6% day shift and 24.4% nights, evenings, or rotating shifts.

Satisfaction With Electronic Health Record

Overall, the CISIES score indicated that Texas has a large proportion of nurses with satisfaction scores ranging from

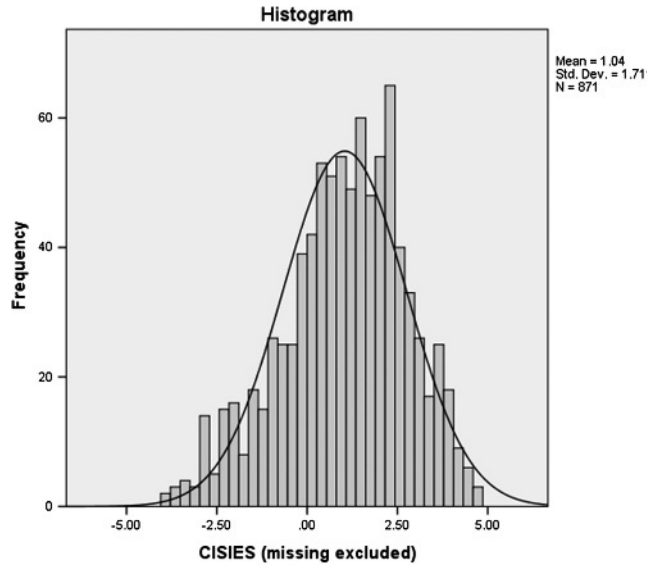

FIGURE 4. Histogram for distribution of CISIES scores for Texas nurses.

2 to 5. Figure 4 presents the distribution of the overall CISIES scores, noting ranges that constitute satisfied (2–5), neutral or not completely satisfied (0.5–1.99), and dissatisfied (0.5). The mean score of 1.04 presents potential opportunity to improve the overall satisfaction of Texas nurses. The satisfaction category of 2 to 5 CISIES scores was converted to a dichotomous variable (coded as satisfied "yes" or "no") for further analyses to address the specific research questions.

The MUMSI was calculated for all respondents based on 24 questions reflecting the maturity of the EHR related to MU. The index score had a mean of 56.53, median score of 59, with a minimum score of 0, and a maximum score of 72. Differences in EHRs related to maturity and satisfaction were examined. Overall, the researchers noted that there were significant differences in levels of satisfaction when examining the MUMSI as a scale variable, which indicates that nurses' satisfaction goes up significantly as the maturity of the EHRs increases with respect to MU indicators. There is a statistically significant difference in those that indicate satisfaction as yes or no from the CISIES (2–5 score) and the mean score of the MUMSI ($t_{606} = 5.60$, $P < .001$).

The relationship between key variables and their relationship to satisfaction were tested while controlling for system maturity using the MUMSI. This approach was deemed to yield the information with the most potential to inform interventions for improving the nurses' experiences using their EHRs by better understanding variation of the EHRs across respondents.

Health Setting Characteristics and Nurses' Satisfaction With Electronic Health Record

When rural areas were compared with urban areas, after controlling for MU maturity, there were significant differences between rural and urban settings, with nurses in rural areas 44% less likely to be satisfied with their EHRs (odds ratio [OR], 0.563; 95% confidence interval [CI], 0.386–0.821; $P = .003$). Level of satisfaction of yes/no was computed by region, while controlling for system maturity using the MUMSI. The Metroplex public health region had the highest occurrence of more than 100 nurses indicating they are satisfied with their EHR as demonstrated by the CISIES scores in the 2 to 5 range. When conducting this comparison and controlling for the maturity of the EHR, these data answer the question "how likely am I to be satisfied by my EHR if I reside in any given region?" The likelihood of satisfaction for each region was calculated as a likelihood ratio as noted in Table 1. This analysis was conducted by comparing the most satisfied region with all other regions while controlling for the maturity of the EHR using MUMSI. These findings are particularly important because it indicates where the improvement efforts should be focused and which regions are most likely to exhibit best practices to inform strategies.

Nurses' Characteristics and Nurses' Satisfaction With Electronic Health Record

No significant differences in satisfaction were identified between the different roles of registered nurses and other respondents. These similarities are consistent after controlling for the maturity of the EHR ($P > .05$). However, staff, directors, managers, and supervisors tended to be more satisfied than respondents in positions such as educators, case managers, and quality (noted as "other") who are 40% less likely to be satisfied (OR, 0.606; 95% CI, 0.382–0.961; $P = .033$).

Informatics competencies have historically examined nurses' expertise with use of computers.[24] The researchers

Table 1. Odds Ratios for Likelihood of Satisfaction by Regions Compared With the Most Satisfied Region (Metroplex)

Region	Likelihood of Being Satisfied	Statistics
Northwest Texas	71%	OR, 0.285; 95% CI, 0.090–0.899; $P = .032$
High Plains	45%	OR, 0.552; 95% CI, 0.324–0.943; $P = .030$
Upper East Texas	81%	OR, 0.186; 95% CI, 0.069–0.503; $P = .001$
Southeast Texas	64%	OR, 0.363; 95% CI, 0.140–0.941; $P = .037$
Gulf Coast	NS	
Central Texas	56%	OR .440, 95% CI .280, .691, $P < .001$
Upper South Texas	49%	OR .506, 95% CI .285, .900, $P = .020$
West Texas	74%	OR .262, 95% CI .129, .530, $P < .001$
Lower South Texas	NS	

NS indicates not significant >.05.

examined the nurse's perception of their expertise to determine any differences in satisfaction with findings that indicated no significant differences in nurses' perception of their computer proficiency and the relationship to EHR satisfaction ($X_2^2 = 3.54$, $P > .05$). These differences remain after controlling for the maturity of the EHR. Therefore, the need to increase computer literacy may not be the best solution at this point in the evolution of nursing informatics competencies. Instead, more explicit focus on best practices in the use of the EHR by nurses and the development and evaluation of competencies aligned with those best practices is potentially needed.

When comparing nurses working different shifts and after controlling for the EHR maturity, nurses were 42% more likely to be satisfied with their EHR when working nights, evenings, and rotating shifts when compared to nurses working day shifts (OR, 1.423; 95% CI, 1.019–1.988; $P = .039$). Additionally, nurses in practice for 6 to 10 years are 78% more likely to be satisfied with their EHRs, while other groups were not significantly different with respect to satisfaction (OR, 1.783; 95% CI, 1.088–2.923; $P = .022$). However, we found age to be a factor in overall satisfaction. When compared with nurses who are 18 to 25 years of age and controlling for the maturity of the EHR, nurses 51 to 60 years are 36% (OR, 0.431; 95% CI, 0.227–0.817; $P = .01$) less likely to be satisfied and nurses older than 61 years are 68% less likely to be satisfied (OR, 0.321; 95% CI, 0.149–0.690; $P = .004$) with their EHR.

Clinical Information System Characteristics and the Nurses' Satisfaction

The researchers then controlled for maturity of the system with the MUMSI to examine characteristics associated with nursing satisfaction with the EHR related to the CIS in use. When comparing differences in the actual CIS, EHR differences were apparent with univariate analysis. However, once the maturity of the EHR was taken into account, there were no significant differences among any of the EHRs reported. This finding would place an important emphasis on helping organizations reach MU regardless of the EHR implemented.

Clinical Decision Support

The MUMSI can be used to determine which of the MU elements appear to be associated with nurses' satisfaction with the EHR when controlling for demographic factors that influence the outcome. These findings can help to inform next steps for improvement strategies; for example, the researchers noted that CDS alerts for supporting clinical decisions related to standards were significantly associated with nursing satisfaction. Nurses were 2.76 times more likely to be satisfied with the EHR when this decision support functionality was present and used compared with nurses who indicated that this type of decision support functionality was not present (OR, 2.758; 95% CI, 1.666–4.566; $P < .001$). However, responses to drug-allergy alerts were not as positive. Nurses were 2.8 times more likely to be satisfied when these alerts were not present (OR, 2.815; 95% CI, 1.591–4.981; $P < .001$). It was notable that drug-drug interaction alerts have similar findings, with nurses 2.3 times more likely to be satisfied when this function is not present (OR, 2.298; 95% CI, 1.348–3.916; $P = .002$). These findings would indicate that there is work to do examining best practices of organizations with well-executed strategies for CDS that support nursing practice rather than detract from it. Given these findings, there may also be implications for usability, design, and workflow improvements.

Other Meaningful Use Functionality Associated With Satisfaction

Other factors associated with satisfaction included electronic reconciliation of medications. When this functionality is present and used, nurses are 2.14 times more likely to be satisfied when compared with nurses who indicated that this functionality was not present in their EHRs (OR, 2.144; 95% CI, 1.176–3.905; $P = .013$). Electronic medication reconciliation is often a more difficult threshold measure to meet when compared with some of the more straightforward functionalities and can require additional expenses from EHR vendors to access electronic pharmaceutical data for medication reconciliation. All other factors examined in a

correlation matrix reflected some weak statistically significant associations between nursing satisfaction and EHR functionality reflected in the MUMSI instrument as follows:

- Capture and display demographic data ($r = 0.142$, $P < .01$)
- Maintain an active list of patient problems and diagnoses ($r = 0.121$, $P < .01$)
- Allow charting of vital signs ($r = 0.10$, $P < .05$)
- Track hospital clinical quality data and yield rates of measures ($r = 0.09$, $P < .05$)
- Create an electronic copy of patient's health information ($r = 0.08$, $P < .05$)
- Generates a list of patients by specific conditions for quality measures ($r = 0.10$, $P < .05$)
- Generates information regarding condition specific education materials ($r = 0.11$, $P < .01$)
- Generates clinical care summaries ($r = 0.12$, $P < .01$)
- Records patients responses to care electronically ($r = 0.09$, $P < .05$)

Another observation is that the additive effect of all of these factors, combined with other factors influencing satisfaction, compounds the importance of the collective impact of MU measures on nursing satisfaction. There are several important standalone factors that are relevant to satisfaction, for example, CDS. These findings indicate that MU at large is an important goal for HCO to reach for nurses to be satisfied with their EHRs.

MANAGEMENT AND SYNTHESIS OF QUALITATIVE CONTENT

A thematic content analysis of the nursing narrative in response to the open-text question was used to analyze the data. The texts were organized in an Excel file (Microsoft, Redmond, WA) and were read and reviewed systematically to identify key concepts by two qualitative researchers from the TNA/TONE Committee research subgroup. The text narrative responses were then reorganized according to concepts and summarized into categorical statements. Further immersion and analysis of the categories with the two lead researchers with informatics expertise were conducted and resulted in a synthesis of comments within the categories that revealed several primary themes noted in Figure 5. A conceptual model was developed by the research subgroup that reflects the overall common concepts detected in the thematic analysis, also noted in Figure 5.

Qualitative analysis of the nurses' narrative responses to the open-ended text question indicated some positive experiences but more commonly indicated issues with system performance and a disruption of the nurse-patient relationship. Additionally, dissonance or distress was noted from the nurses' desire to practice to the best of their ability with EHRs that do not always align with that provision of nursing care. As such, the research subgroup and other content experts that reviewed these results in focus groups reflected that these qualitative findings are supported by the Polarity Management Map developed by Polarity Partnerships, LLC (Sacramento, CA). This model informs action steps in a four-quadrant map noting action steps for early warning signals for each quadrant of the map.[25]

Within the qualitative data, we detected negative early warning signs with these systems that present an opportunity for improvement to nursing practice. The polarity model notes that to address these early warning signals with issues such as design problems, lack of interoperability, and negative impacts on quality and safety, measurable indicators with timelines to address improvement are needed. The positive results of the survey should be disseminated and reinforced in a format that brings value and respect to technology and practice. According to this action-oriented model, the

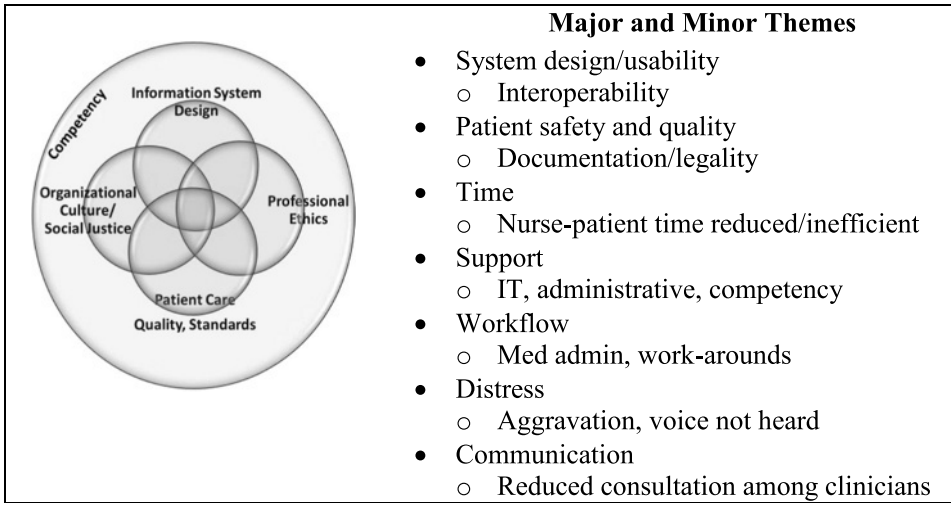

FIGURE 5. Narrative themes regarding nurses experiences with their EHRs.

questions "What? Who? By when?" should be addressed. The findings from the EHR statewide study and use of the Polarity Management Map[26] will help to inform statewide improvement strategies.

The data from both qualitative and quantitative analyses support the identification of regional best practices and to create forums to communicate and share details with those areas that are more challenged with these systems. Additionally, there are clear indications that the more mature the EHR is with respect to MU measures, the more satisfied the nurses are with the system. This would emphasize a strategy to support statewide efforts to help organizations and regions achieve MU, not only for the incentives and disincentives with the CMS EHR Incentive Program but also to allow Texas nurses to practice safely and effectively to the best of their ability.

These data will be further analyzed to correlate the findings on the quantitative analysis with the results of the qualitative findings. This mixed-methods approach can comprehensively inform further improvement strategies within Texas as well as provide guidance for other states.

RECOMMENDATIONS

Gathering and analyzing rich data from nurses provided for significantly robust recommendations to establish a roadmap for improvement in the usability of EHRs for nurses in Texas. The study results were synthesized and examined by the full TNA-TONE HIT Committee and recommendations made to the respective TNA and TONE Boards. Recommendations from the full committee with potential action items and interventions are highlighted in Table 2.

Table 2. Summary of Qualitative Theses, Actions and Interventions Recommended

Theme	Potential Action Items/Interventions
System design/usability	Utilize satisfied characteristics to improve dissatisfied and utilize dissatisfied characteristics to inform improvement strategy
Patient safety and quality/legality	Integrate with relationship to design/usability
Time: away from patient care delivery	Focus groups exploring clinician-based solutions
Time: inefficiency	Focus groups exploring designer-based solutions (vendor and IT implementation)
Support	Assess/deploy needed resource support throughout organization
Workflow	Institute leadership-adopting a culture of improvement related to HIT
Distress	Provide collegial approach, interprofessional solutions, and openly monitor progress
Communication	Emphasize open, consistent, throughout organization

The focus of the interventions will be to utilize characteristics that indicate satisfaction to inform improvement strategies and interventions in areas of the state that are exhibiting challenges with nurse satisfaction. The researchers will conduct regional focus groups of stakeholders, including practicing nurses, to inform strategies over the next 3 to 6 months. These focus groups will result in content to be shared at a statewide meeting of academic and practice representatives from the regions to report findings and develop further tactical strategies to address the findings. Detailed reports by region can also be used to inform regional improvements. The researchers plan engagement of the vendor community along with other stakeholders to examine usability and design challenges and connect with subject matter experts nationally to assist with further interpretation of findings related to usability and workflow redesign interventions. Additional plans include working with the Rural Institutes, Regional Extension Centers, and other organizations to support rural providers and hospitals in achieving MU and optimization of EHRs. The researchers will conduct further investigation into the CDS findings to inform improvement strategies explicitly around usability, design, and strategies of CDS optimization for nursing. The TONE will assist with engagement of executive leadership in Texas hospitals to inform hospital leadership of findings and to strategize improvements to address communication and support based on quality improvement strategies. Findings will be presented to the statewide deans and directors of the schools of nursing for an open discussion of integrated informatics in the curriculum. Timeline for next steps that are recommended span from October to December 2015, where the formulation of intervention strategies were first defined, followed by deployment of those intervention strategies during the year of 2016, from January to December. Then from October to December 2017, the researchers would measure the impact of the intervention strategies via the degree of improvement in CISIES satisfaction scores. Finally, the researchers will encourage national efforts to invite other states to follow similar strategies adopted in Texas to utilize evidence to inform improvement strategies to optimize EHRs for nurses.

CONCLUSION

This report is the result of a study that has been a longstanding project for the TNA-TONE HIT Committee, originally conceptualized after the committee formed in 2010. It is an expansive work effort from across the state with tremendous support from TNA, TONE, and statewide leadership, including the Texas Team Practice and Education Committees. The nursing informatics leadership from across the

nation has stepped up to support Texas in this effort in providing tools (CISIES) and lending their expertise to help shape new tools (MUMSI) to fully execute the study. As a result, Texas is in a unique position to help inform national strategies for improving EHR functionality and other point of care technology to optimize these systems for nurses practicing within interprofessional teams.

Nurses play a critical role within interprofessional teams shaping HIT in providing better patient care, as is emphasized in the IOM Future of Nursing report.[27] Through this study and the data collected and analyzed, we have heard the voices of nurses in Texas positively supporting the use of EHRs in their practice while at the same time calling for the improvement of these systems on behalf of our profession, patients, and the entire interprofessional team.

This report is a result of nurses speaking out on behalf of patient care. The recently released TIGER report[2] calls for innovative nurse leaders to step forward and help shape the use of technology to accomplish the Triple Aim of improving the quality of care, population health, and reducing the overall cost of care. The TIGER Foundation report, The Leadership Imperative: TIGER's Recommendations for Integrating Technology to Transform Practice and Education, states: "Leadership drives, empowers, and transforms."[27] Texas nurses stand poised to use these study findings to inform plans of action to lead transformational change.

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