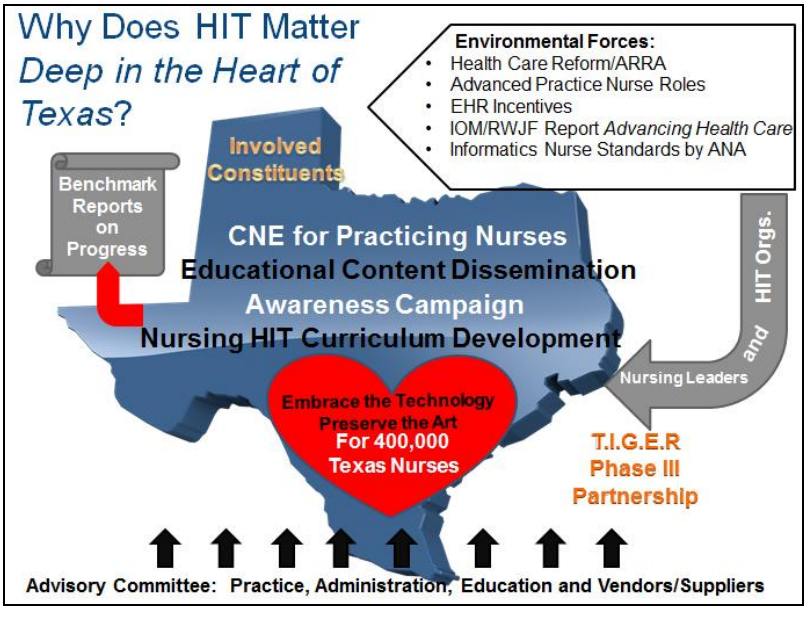
Statewide Study Assessing the Experience of Nurses with their Electronic Health Records

REPORT TO THE TNA and TONE Boards

Originally Prepared
October 15-16, 2015

Updated January 20, 2016



Texas Nurses Association and Texas Organization of Nurse Executives Health Information Technology Committee

TEXAS NURSES ASSOCIATION

TONE
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Acknowledgements

The TNA-TONE Health IT Committee would like to thank the TNA staff for support facilitating communication with executive leadership at TNA and TONE and coordinating meetings and other resources to make this study possible.

We would also like to acknowledge and thank Texas Tech University Health Sciences Center for Institutional Review Board oversite of the study and the Texas Tech University Health Sciences Center School of Nursing Education Support Department for website site development, hosting of the survey, provision of Qualtrics.com software, as well as technical and statistical support.

A special thanks to Dr. Brian Gugerty for his support and guidance with the use of the Clinical Information Systems Implementation Evaluation Scale (CISIES). In addition, Dr. Gugerty contributed to the content validity focus group in the development and refinement of the Meaningful Use Nursing Sensitivity Index (MUMSI) and as a subject matter expert interpreting study results. Along with Dr. Gugerty, a large group of healthcare professionals supported the MUMSI development and interpretation of study results, including:

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Executive Summary

The healthcare industry is undergoing major transformation to establish an interoperable health information technology infrastructure to connect the nation with electronic health records (EHRs) and health information exchanges (HIE). This informatics revolution is impacting all aspects of the nursing profession (Murphy, 2012). As such the Texas Nurses Association/Texas Organization of Nurse Executives Health IT (HIT) Committee was charged with examining how Texas nurses across the state were impacted by these EHRs and with establishing baseline measures of satisfaction to ***inform with evidence*** improvement strategies to be deployed in 2016, and subsequently re-evaluated in 2017.

To accomplish these goals, an online nursing survey, Clinical Information Systems Implementation Evaluation Scale (CISIES) was used to evaluate the perceptions of Texas nurses related to the usability and usefulness of their institution's clinical information system used in patient care delivery. This information will help to inform statewide efforts to improve the use of HIT for nurses and associated stakeholders. In addition, as indicated in earlier reports to the TNA and TONE Board, findings will be used to inform health care organizations about the current experience of Texas nurses with clinical information system (CIS)/electronic health record (EHR) implementation, here-to-for referred to simply as EHR. The report may also be used as a foundation for future studies and comparisons with national benchmarks.

The report is organized according to questions addressed by the research subcommittee:

1. What are key issues with the current deployment of the electronic health record in the practice setting, and specific questions to inform improvement strategy?
    - What is the relationship between *health setting* characteristics and the nurses' perceptions of their EHR?
    - What is the relationship between the *nurses' characteristics* and the nurses' perceptions of their EHR?
    - What is the relationship between *EHR characteristics* and the nurses' perceptions of their EHR?
2. What are the related core HIT competencies that should be covered in nursing education and in practice?
3. What are the themes and sub-themes that emerge from the narrative comments (qualitative data) by nurses about using their EHRs that may inform improvement strategies?

The survey was launched September 23, 2014, and resulted in 1,177 responses including results of the CISIES, combined with demographic information and a Meaningful Use Maturity-Sensitive Index (MUMSI) that provides an ability to control for factors that might influence the nurses' satisfaction with their EHR. The study results indicate the importance of examining nursing satisfaction in terms of the maturity of the EHR with respect to nationally established standards under the meaningful use (MU) requirements created by the HITECH Act.

Other important findings are as follows:

- Satisfaction mean of 1.71 indicating neutrality or some dissatisfaction; however a

substantial proportion of scores in the 2-5 range indicated nurses' satisfaction with their EHRs.

- Regional differences were apparent in terms of satisfaction of EHRs with significantly higher satisfaction within the Metroplex public health region.
- Younger nurses were more likely to be satisfied with their EHRs than older nurses, yet years of nursing and perceived competency with computers also impacted this finding.
- Urban settings reported significantly higher rates of satisfaction than rural settings that remained significant even after controlling for the maturity of the EHR;
- Nursing informatics, financial support and executive leadership result in more positive feedback when the nurse's narrative responses to an open-ended text questions were examined.
- Usability, design and workflow challenges resulted in frustrations and time away from patients.
- Potential regulatory issues were noted with statements related to "intentional entry of erroneous/false data" to "work around the system", and "first-hand knowledge of patient safety events" related to Health IT.
- The combined results of the qualitative and quantitative data can be used to further examine details on trends related to both positive and negative narratives that would indicate region, EHR-type, rural or urban challenges, etc., to inform improvements.
- Frustrations were noted with physicians and other nursing colleagues who resisted the use of technology.
- Dissatisfaction was associated with use of Clinical Decision Support (CDS) for drug-drug and allergy alerts, whereas CDS related to standards and protocols for clinical decisions was associated with nursing satisfaction.

The recommended next steps based on these findings are as follows:

- Convene a statewide meeting in Austin of academic and practice representatives to report study findings and develop tactical strategies to address the findings. Detailed reports by region can also be used to inform regional improvements.
- Work with the Rural Institutes, Regional Extension Centers, Texas Organization of Community and Rural Hospitals (TORCH) and other organizations to further support rural providers and healthcare organizations in achieving meaningful use and optimization of EHRs.
- Initiate further investigation into the Clinical Decision Support (CDS) findings to inform improvement strategies explicitly around usability, design and strategies of CDS optimization for nursing.
- Establish a forum for regulators and stakeholders[1] to discuss policy initiatives regarding barriers to and solutions for use of EHRs.
- Engage executive leadership in Texas healthcare organizations through partnership with TONE

[1] Stakeholders include practice, administration, education and technology vendors/suppliers.

and TNA to inform -healthcare leadership of study findings and to develop quality improvement strategies addressing communication and support.

- Communicate and convene with the Texas Team Executive Committee and Practice and Education Committees to inform nursing leadership across Texas of the study findings and to solicit input for improvement strategies.
- Engage the Deans and Directors of the schools of nursing (and other schools of health professions) for an open discussion of integrated informatics in curriculum.
- Timelines and next steps recommended are reflected in the figure below. Included in the timeline is formulation of interventions from October to December 2015 followed by deployment of interventions during the year 2016. A post-intervention survey to measure the impact of interventions on the satisfaction scores of the CISIES will be initiated in 2017. The outcome of the interventions aim to increase the CISIES satisfaction scores so that they reach into the 2-5 range by close of 2017
- Engage other content experts across the nation including usability, informatics and TIGER leadership to inform improvement strategies on usability, system design, workflow, competency development and other related areas..
- Consider establishing a national strategy led by Texas, inviting other states to participate in collecting benchmark date.

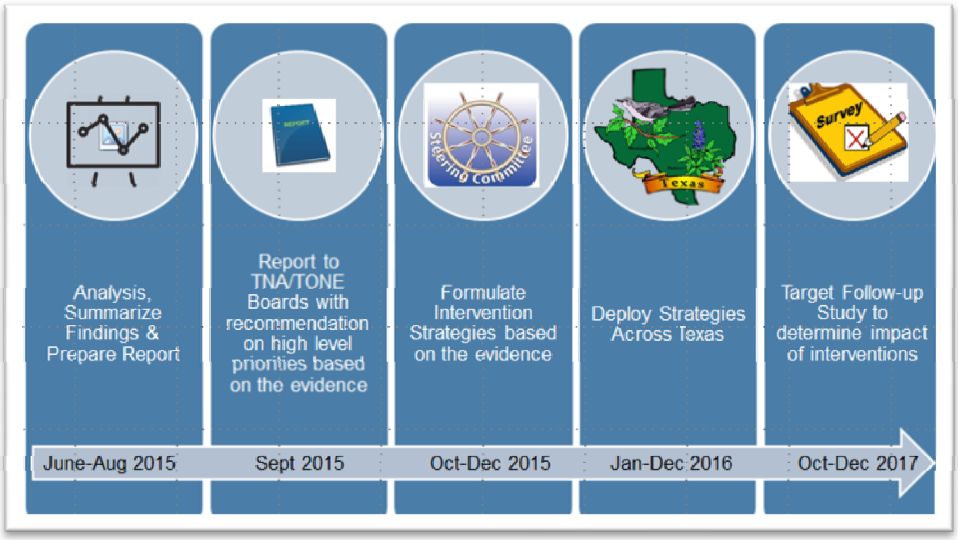


Figure of Timeline for Final Report and Next Steps

In summary, these findings present an extraordinary opportunity for the TNA/TONE partnership to establish a national presence on behalf of nursing not only in Texas, but nationwide to work towards strategies to improve EHRs' functionality for nurses working within interprofessional teams. The efforts of the TNA/TONE Health IT Committee reinforce the TIGER vision and the IOM Future of

Nursing Report that reflect the importance of improving the EHR to support nursing practice and patient outcomes. Optimal use of the EHR by nurses will contribute to reinforcement of the National Quality Strategy within the U.S.

This study and the subsequent findings provide a unique opportunity for listening to the voices of Texas nurses, expressing how Health IT might be improved. On behalf of Texas nurses, we thank the TNA and TONE Boards respectively for their leadership and support.

Introduction

With the passage of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009,[2] Texas nurses faced a rapid uptake of technology required by this legislation. To evaluate the changing health information technology (HIT) environment and explore next steps, the Texas Nurses Association (TNA) Board of Directors formed an advisory committee. Soon after, the TNA Board joined with the Texas Organization of Nurse Executives (TONE) to create a statewide partnership to study the impact of HIT on Texas nurses and develop recommendations.

Purpose

The purpose of the statewide multi-organization study is to identify key issues relating to the nurse's experience using clinical information systems (CIS)/electronic health records (EHR), here-to-for referred to simply as EHR, and other point of care technology. Specifically, this descriptive and exploratory study aims to answer the following questions about CIS/EHR use by the current nursing workforce in Texas:

Research Questions

1. What are key issues with the current deployment of the electronic health record (EHR) in the practice setting, and specific questions to inform improvement strategy?
   a. What is the relationship between *health setting* characteristics and the nurses' perceptions of their EHR?
   b. What is the relationship between the *nurses' characteristics* and the nurses' perceptions of their EHR?
   c. What is the relationship between *EHR characteristics* and the nurses' perceptions of their EHR?
2. What are the related core HIT competencies that should be covered in nursing education and in practice?
3. What are the themes and sub-themes that emerge from the narrative comments (qualitative data) by nurses about using their EHRs that may inform improvement strategies?

Sampling and Survey Response

The TNA/TONE online survey was deployed through an email sent to staff nurses from the Chief Nurse Officer (CNO) of multiple health care organizations inviting voluntary and anonymous participation. The statewide survey was launched September 23, 2014. The initial sampling strategy

[2] Health Information Technology for Economic and Clinical Health Act (2009) Public Law 111-5 American Recovering and Reinvestment Act of 2009, Title XIII Health Information Technology for Economic and Clinical Health Act.

focused on over sampling for rural settings. This sampling strategy resulted in a small response of approximately 250. Secondary sampling strategy utilized a snowball approach with distribution of the invitation to participate in the study, the survey link, and communication of purpose through emails sent by TNA and TONE leadership. This strategy resulted in 1,177 total survey responses. Of the 1,177 demographic and survey data, approximately 12-15 respondents (depending on demographic) were missing data, and 190 failed to respond to the survey. Final data analysis to inform the recommended strategies was reflective of comprehensive responses from 987 participants. Figure 1 demonstrates the volume increase in participants between the initial launch and the revised sampling strategy. One notable event that occurred in late 2014 impacted the initial response and potentially the robust final response was the Ebola incident in Dallas, Texas. We paused to address preparedness and to respect the added responsibilities of nurses and nursing leadership at this time.

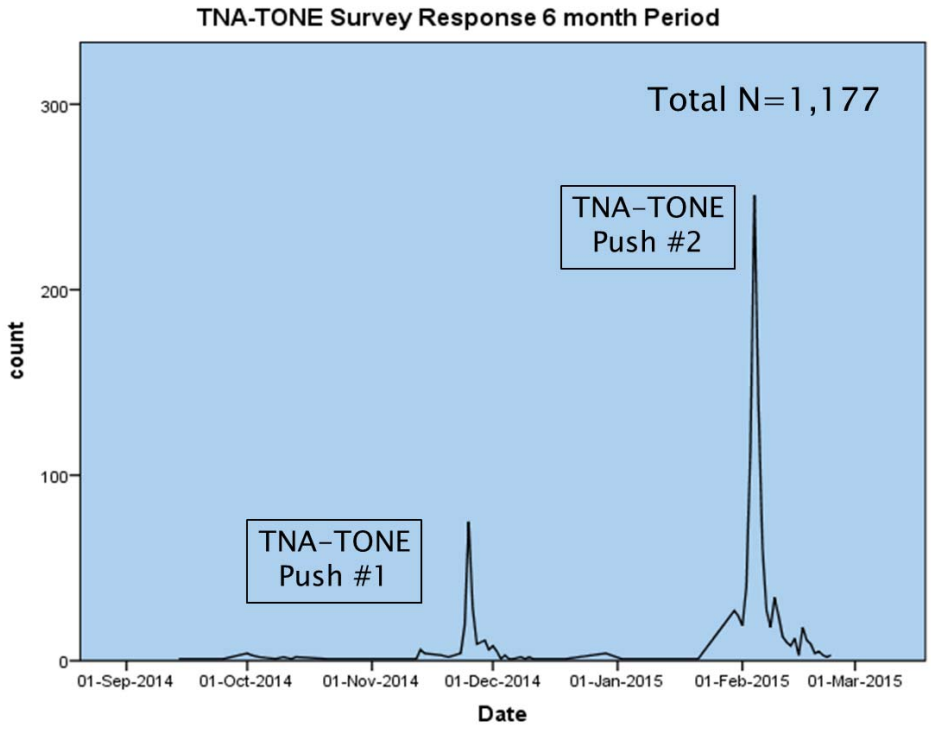


Figure 1. *Study responses from a 6-month period from September 2014 through February 2015*

Study Design and Instrumentation

A descriptive and exploratory research study of the current nursing workforce in Texas, using a previously validated survey instrument, was conducted in select acute care facilities and associated acute care, ambulatory/episodic care and long term care (LTC) units, collectively -- “Health Care

Organization" -- to answer the research questions. Demographic data collection aligned with the Texas Nursing Workforce Studies Center data collection standards including regions (Texas public health regions), age, years in nursing and other relevant categories so that further analyses can be done potentially combining Texas datasets. The survey was hosted by Texas Tech University Health Sciences Center School of Nursing Education Support Department and utilized Qualtrics.com software for study data collection; SPSS 22.0, NVIVO and SAS 9.4 were used for data analyses. The webpage portal is reflected in Figure 2, noting demographics and regions reflecting Texas public health regions.

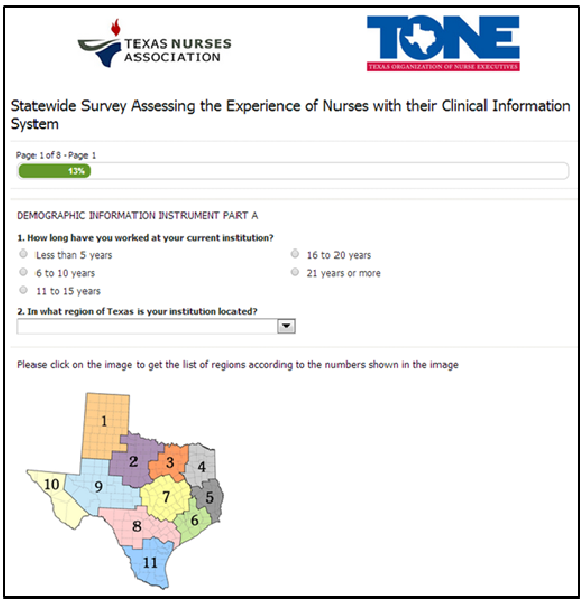


Figure 2. *First page of the TNA-TONE Statewide Online Survey*

Clinical Information Systems Implementation Evaluation Scale (CISIES)

The online survey utilized the Clinical Information Systems Implementation Evaluation Scale (CISIES) Survey by Brian Gugerty as a well-known measure of nurses' CIS satisfaction (Gugerty, Maranda, & Rook, 2006). This instrument assesses user satisfaction across organizations, reflecting attributes of technological innovation and is sensitive to the adopter's characteristics in both formative and summative evaluations of CIS implementation. A summative examination post EHR implementation was conducted to inform our Texas strategies to optimize these systems for Texas nurses.

Assessing end-user perceptions of specific aspects of system functionality, usability and usefulness is essential to identifying approaches that can be used to make strategic improvements in CIS knowledge and implementation across Texas. The primary purpose of the TNA/TONE HIT study was to inform a strategy to better prepare Texas to optimize EHRs as a result of the rapid deployment of clinical information technology under the HITECH Act and CMS EHR Incentive Program. The CISIES was an excellent tool to help evaluate both academic and practice setting plans to address HIT

use by nurses. Figure 3 notes the first few questions of the 37 item CISIES survey. The survey asks the participant to indicate if they strongly disagree, disagree, somewhat disagree, somewhat agree, agree or strongly agree with the statement noted. There are reverse coded items within the survey that enhance user responses.

Please respond to the following questions:

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
01. Overall, I prefer using the system than the old way of doing things	○	○	○	○	○	○
02. I can depend on the accuracy of the system	○	○	○	○	○	○
03. The training I received was adequate	○	○	○	○	○	○
04.I feel confident in my ability to assist others in using the system.	○	○	○	○	○	○
05. Adequate resources were available when I was learning to use the system	○	○	○	○	○	○
06. I feel the use of the system has improved the quality of patient care	○	○	○	○	○	○
07. The use of the system reduces errors	○	○	○	○	○	○
08. The system is more efficient than the old way of doing things	○	○	○	○	○	○
09. The system has improved my practice	○	○	○	○	○	○
10. The system allows me to spend more time on other aspects of patient care	○	○	○	○	○	○

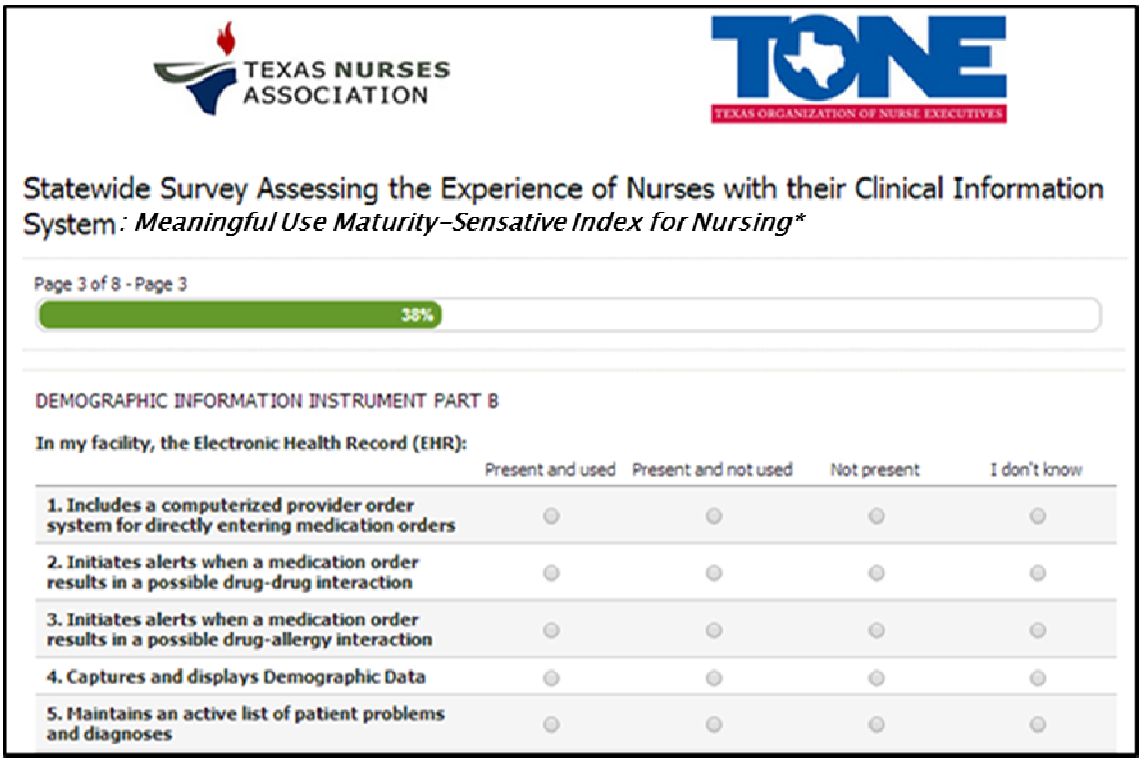
Figure 3. *Clinical Information System Implementation Evaluation Scale (CISIES)*

Meaningful Use Maturity-Sensitive Index (MUMSI)

Given the rapid update of certified EHRs under the HITECH Act, the research team wanted to control for the maturity of the EHR within the clinical setting where the nurses practiced. As such, the research team developed an EHR "Meaningful Use Maturity-Sensitive Index" (MUMSI). The MUMSI allowed for analysis of differing levels of functional status, or maturity, of the given EHR using the meaningful use (MU) measures as a proxy for maturity as outlined by Stage 1 MU.[3] Content validity was established with a two-round Delphi technique method with quantitative instrument design strategies (Lynn, 1986).

The MUMSI was deployed within the demographic information in the survey portal, and Figure 4 reflects 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.

[3] Department of Health and Human Services (2010) 42 CFR Parts 412, 413, 422 et al. Medicare and Medicaid Programs; Electronic Health Record Incentive Program; Final Rule



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Statewide Survey Assessing the Experience of Nurses with their Clinical Information System: *Meaningful Use Maturity-Sensative Index for Nursing**

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38%

DEMOGRAPHIC INFORMATION INSTRUMENT PART B

In my facility, the Electronic Health Record (EHR):

	Present and used	Present and not used	Not present	I don't know
1. Includes a computerized provider order system for directly entering medication orders				
2. Initiates alerts when a medication order results in a possible drug-drug interaction				
3. Initiates alerts when a medication order results in a possible drug-allergy interaction				
4. Captures and displays Demographic Data				
5. Maintains an active list of patient problems and diagnoses				

Figure 4. *Meaningful Use Maturity-Sensitive Index (MUMSI).*

Combined Instrumentation of CISIES and MUMSI

Both the CISIES and the Meaningful Use Maturity-Sensitive Index yielded strong inter-rater reliability, .881 and .889, respectively. 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 done to assure the research team that there was immediate overlap in the variables explaining the CISIES and the MUMSI. Figure 5 graphically illustrates the performance of these two surveys when combined and analyzed using an exploratory factor analysis methodology.

Exploratory factor analysis (EFA) is a statistical method used to uncover the underlying structure of a relatively large set of variables. EFA is a technique within factor analysis with the overarching goal is to identify the underlying relationships between measured variables. EFA is a statistical method to reduce the larger set of variables: 1) to discover patterns among the variables. 2) to condense variables to a smaller number of variables called factors (subscales), and 3) to examine categories or "factors" of clustered questions. In using these methods to examine our survey data with both the 37 item CISIES and the 24 item MUMSI, clear patterns emerge as noted in Figure 5. The MUMSI stands alone as a covariate that clearly examines the functionality and maturity related to stage 1 measures of meaningful use, and as a result performed well as a covariate to control for the impact of maturity on the overall satisfaction of nurses with respect to their experiences with their

EHR. Additionally notable is the pattern of two specific questions on the CISIES related to CDS alerts that isolate as a distinct factor in the left hand corner of the figure. We examined this finding specifically within the results section to determine if this was a positive or negative indication of satisfaction. All other factors shared variance related to the CISIES with one particular factor explaining most of the variance with respect to nursing satisfaction with the EHR.

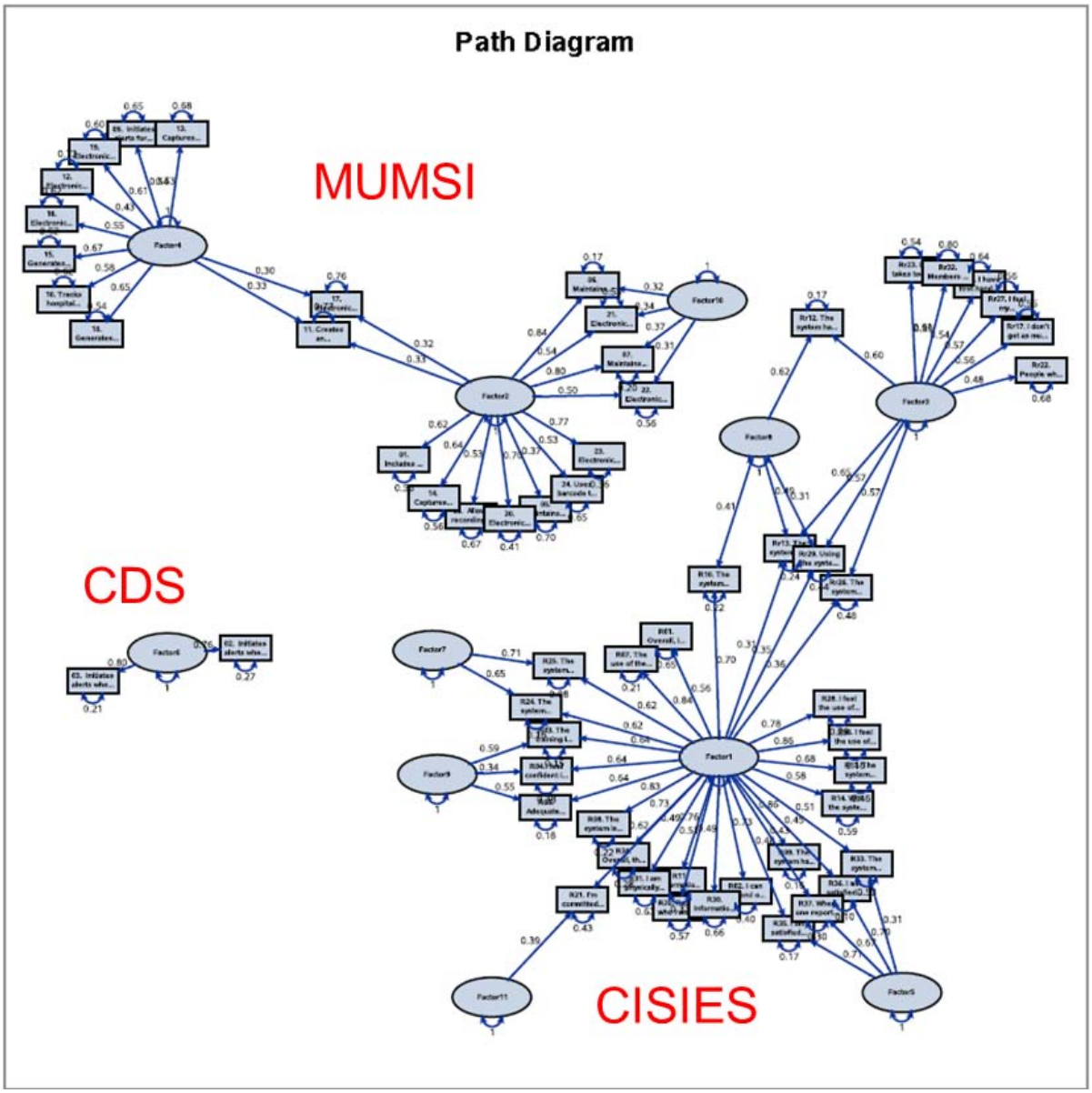


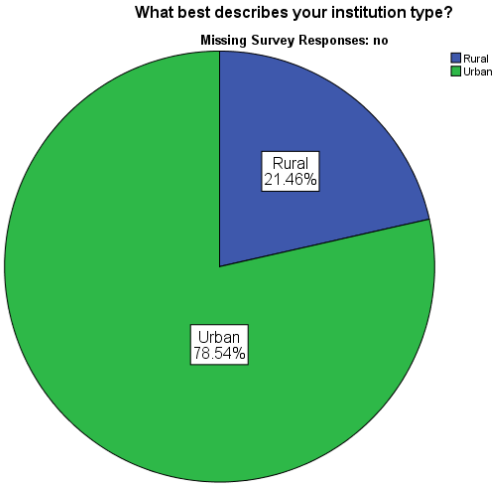
Figure 5. *Exploratory Factor Analysis examining CISIES and MUMSI with three distinct factors including MUMSI, Overall Satisfaction (further subscales noted here), and Clinical Decision Support.*

Study Results

Demographics

Rural and Urban Characteristics

Of the total 1,177 respondents, 987 responded to all survey questions. Of the respondents who completed all survey questions, 21.4% (n=211) represented a rural setting and 78.5% (n=772) an urban setting (see Figure 6). Rural respondents were 57.4% acute care, 10.9% ambulatory, 0.5% long term care and 30.8% other. Urban respondents represented 55.2% acute care, 12% ambulatory, 1.4% long term care and 31.2% other.



What best describes your institution type?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rural	211	21.4	21.5	21.5
	Urban	772	78.2	78.5	100.0
	Total	983	99.6	100.0	
Missing	System	4	.4		
Total		987	100.0		

Figure 6. Rural versus urban distribution of complete survey respondents

Overall Characteristics

Overall, 68.3% of participants indicated they were direct care providers with 31.7% indicating they did not provide direct care. In addition, 62.6% identified their role as staff, 13.5% as managers/director/supervisor with 23.9% reported as “other.” Males represented 8.7% of the sample and females 91.3%. Race was predominantly White Caucasian at 83.6%, 5.6% Black/African American, and the remainder was categorized as “other” at 10.8%. In terms of experience, 19.4% noted less than 5 years in nursing, and 41% reported over 20 years of nursing experience. Participants who worked days represented 74.6% of participants, and 24.4% working nights, evenings or rotating shifts. Appendix A reflects details on demographics presented.

Satisfaction with EHR

Overall the CISIES score indicate that Texas has a large proportion of nurses with satisfaction scores ranging from 2-5. Figure 7 presents the distribution of the overall CISIES scores noting what constitutes satisfied (2-5), neutral or not completely satisfied (0.5-1.99) and dissatisfaction (0.5). The

mean score of 1.04 presents opportunity to “move the needle” of overall satisfaction . The satisfaction category of 2-5 CISIES scores was converted to a dichotomous variable for further analyses to address the specific research questions.

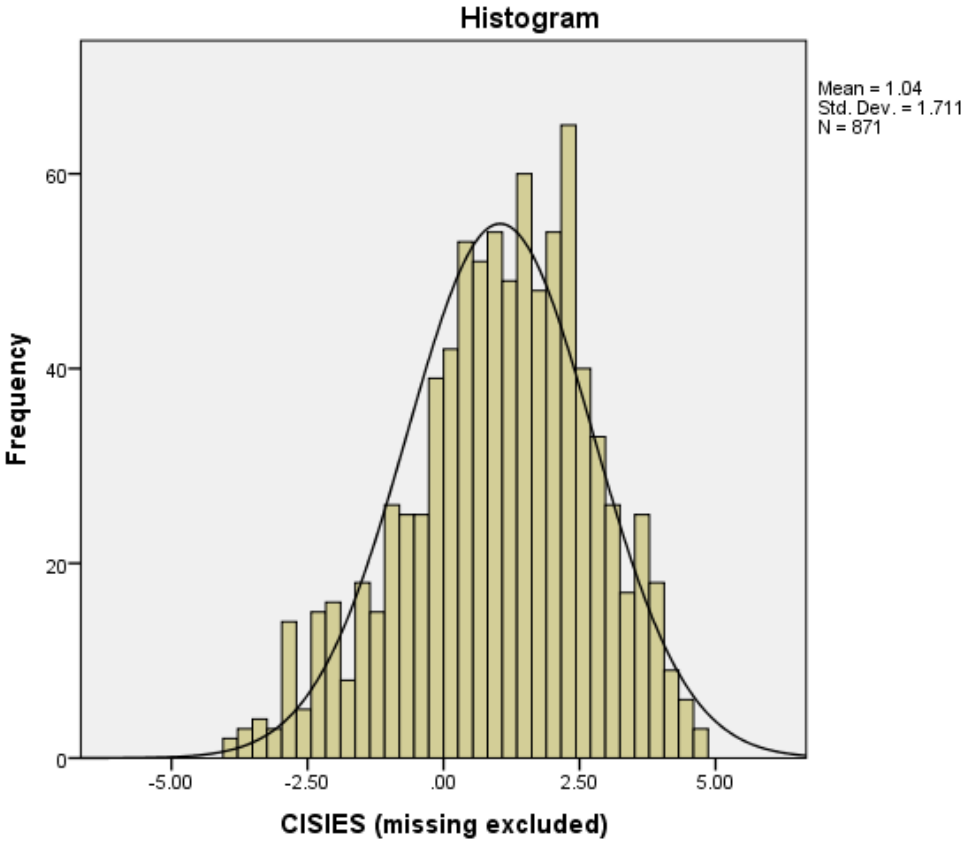


Figure 7. *Histogram for distribution of CISIES Scores for Texas Nurses*

The MUMSI was calculated for all respondents based on 24 questions relating to the maturity of the EHR related to MU. The index score had a mean of 56.53, median score of 59, minimum score of 0 and a maximum score of 72. Differences in EHRs related to maturity and satisfaction.

Overall, it was noted that there were significant differences in levels of satisfaction when examining the meaningful use maturity index as a scale variable, indicating that nurses’ satisfaction goes up significantly as the maturity of the EHRs increase with respect to meaningful use. There is a statistically significant difference in those that indicate satisfaction “Yes” or “No” from a CISIES of 2-5 score and the mean score of the MUMSI. Figure 8 examines the difference with 95% CI and mean comparisons between the two groups indicating significant differences in the MUMSI ($t(606) = 5.60$, $p < .001$.

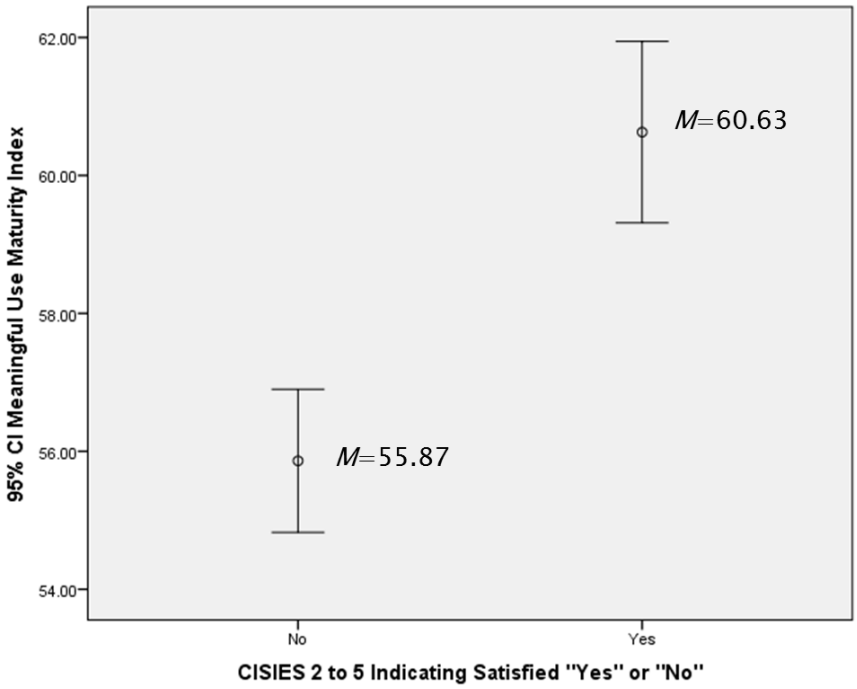


Figure 8. *MUMSI mean comparison of nurses indicating satisfaction "Yes" or "No" t(606) = 5.60, p < .001*

Exploratory Factor analysis was conducted to examine subscales explaining satisfaction. Subscales identified were confidence in the effectiveness of the system, explaining most of the variance, followed by Impact on Interprofessional Team Effectiveness and Outcomes, system support and resources, communication of information and impact of the system on work satisfaction.

Preliminary multiple regression has been completed to examine characteristics predictive of satisfaction with CISIES while controlling for the maturity of the EHR using the MUMSI developed for this study (McBride & Tietze, 2015). The MUMSI is significantly associated with nursing satisfaction indicating that the more mature the system is with respect to federal regulations required to meet MU the more satisfied nurses were with their EHRs.

Research Question 1 (Quantitative Analysis)

Key variables were tested for relationship to satisfaction while controlling for system maturity (MUMSI). This approach was deemed to yield the most impactful interventions, going forward, for improving the nurses' experiences using their EHRs. Each of the following comparisons addresses the quantitative research questions (1. a., b. and c.)

Research Question 1.a.

What is the relationship between *health setting* characteristics and the nurses' perceptions of their EHR?

Geographic region

When comparing rural areas to urban areas, after controlling for MU maturity, significant differences appear between rural and urban settings, with nurses in rural areas 44% less likely to be satisfied with their EHRs (OR 0.563, 95% CI 0.386, 0.821, *p*=.003) (see Figure 9).

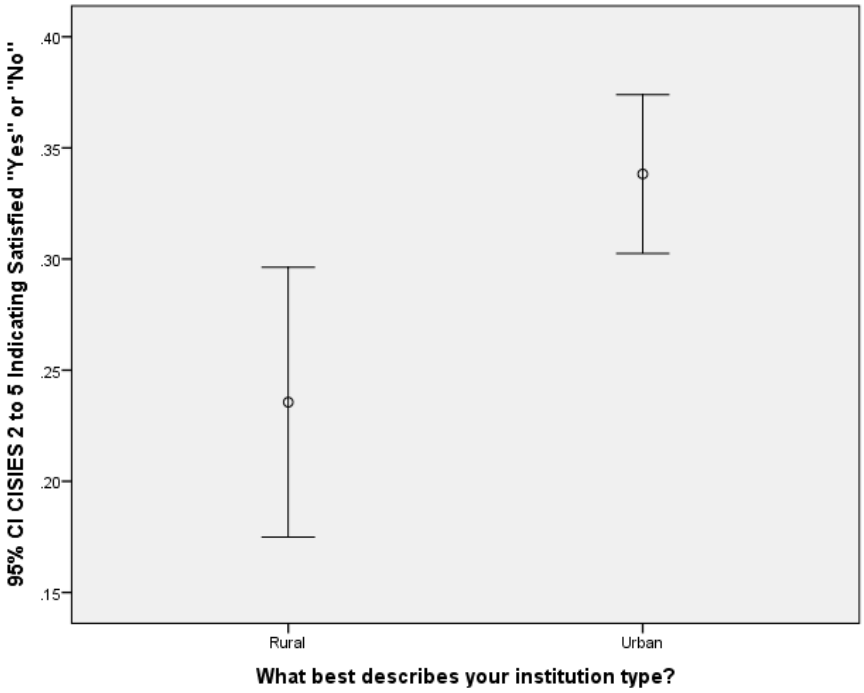


Figure 9. *Reflecting Rural compared to Urban Proportion of Satisfied Nurses in the 2-5 CISIES range [without controlling for maturity of the EHR]. These differences persist after controlling for maturity of the EHR*

Level of satisfaction of Yes/No was computed by region while controlling for system maturity (MUMSI). Figure 10 illustrates the satisfaction Yes/No trend by region. The Metroplex public health region had the highest count of nurses indicating they are “satisfied” with their EHR as demonstrated by CISIES scores in the 2-5 range.

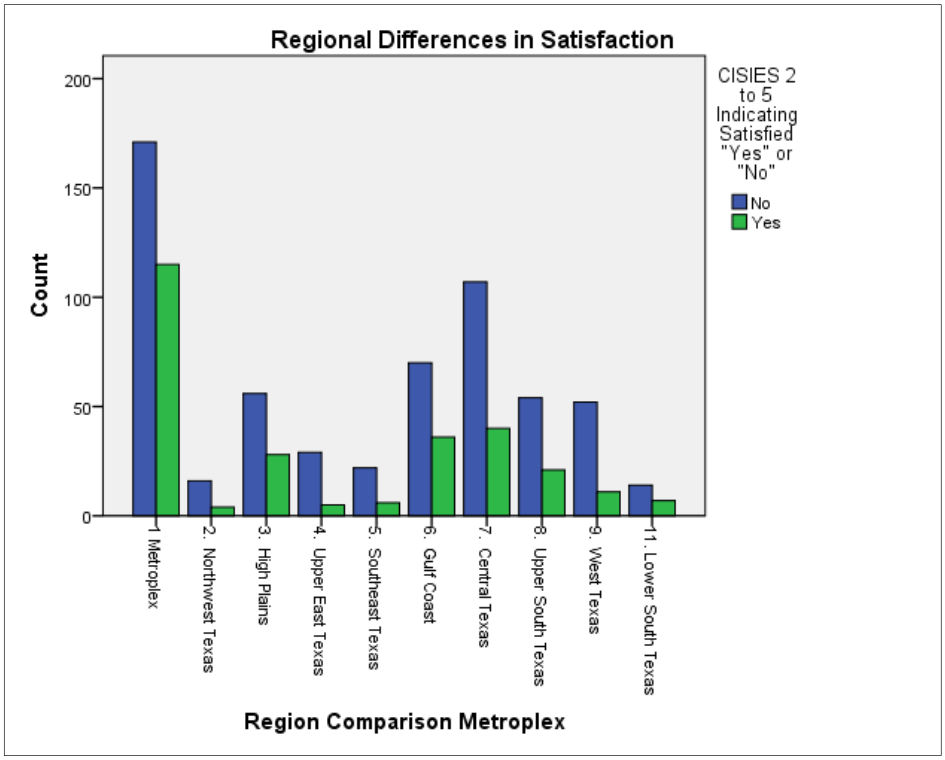


Figure 10: *Regional differences for satisfied "Yes" and "No."*

All regions were compared to an index of a region with the highest satisfaction level (Metroplex) (see Table 1). When conducting this comparison and controlling for the maturity of the EHR, the data answered 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 can be calculated into a likelihood ratio as noted in the table below. This analysis is done by comparing the most satisfied region to all others while controlling for the maturity of the EHR.

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

Region	**Likelihood of being Satisfied**	**Statistics**
2. Northwest Texas	71%	OR .285, 95% CI .090, .899, p = .032
3. High Plains	45%	OR .552, 95% CI .324, .943, p = .030
4. Upper East Texas	81%	OR .186, 95% CI .069, .503, p = .001
5. Southeast Texas	64%	OR .363, 95% CI .140, .941, p = .037
6. Gulf Coast	NS	
7. Central Texas	56%	OR .440, 95% CI .280, .691, p < .001
8. Upper South Texas	49%	OR .506, 95% CI .285, .900, p = .020
9. West Texas	74%	OR .262, 95% CI .129, .530, p < .001
11. Lower South Texas	NS	

Note: Regional 10 is Upper Rio Grande and not included due to insufficient volume with no variability

Research Question 1.b.

What is the relationship between the *nurses' characteristics* and the nurses' perceptions of their CIS/EHR?

Role

No significant difference in satisfaction was demonstrated regarding different roles when registered nurses were compared to advanced practice and nurses who indicated other roles. These similarities are consistent with control for the maturity of the EHR. No significant difference (p>.05) was found based on the role of the registered nurse

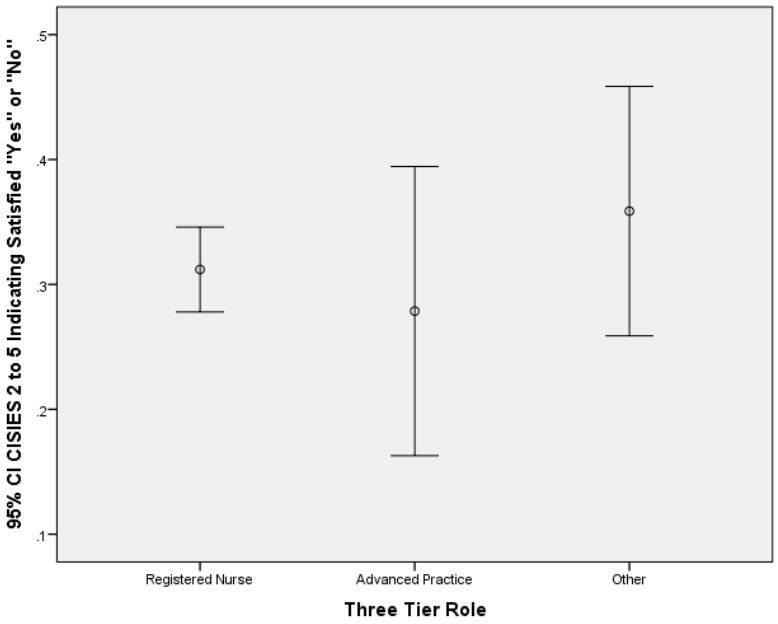


Figure 11. Comparing Nursing Role to Satisfaction

Position

Staff, directors, managers and supervisors tended to be more satisfied than nurses in positions such as educators, case managers and quality improvement managers (noted as "other" in bar chart of Figure 11) who are 40% less likely to be satisfied with their EHR systems (OR .606, 95% CI .382, .961, *p*=.033).

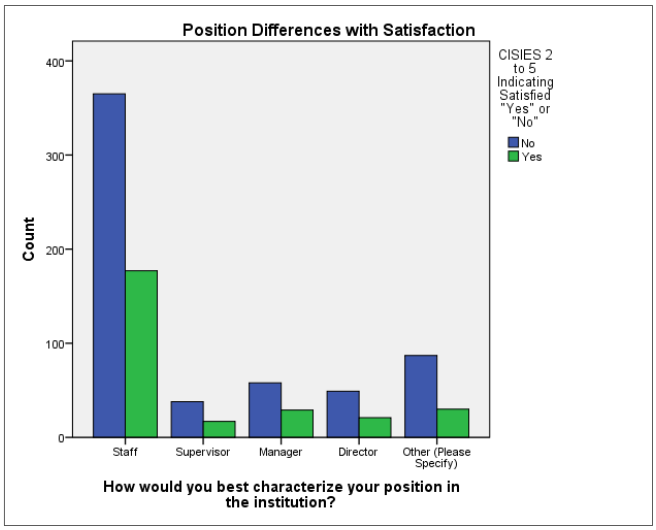


Figure 11. *Position differences comparing management to staff indicate significant differences with staff, supervisors, managers and directors more likely to be satisfied than "other" positions.*

Computer competency (novice to expert)

Informatics competencies have historically examined nurses' expertise with use of computers (Staggers, et al., 2002). In this study the researchers examined the nurses' perception of their expertise in relation to satisfaction. Figure 12 provides the counts by category; however, there were no significant differences in nurses' perception of their computer proficiency and whether or not they are satisfied with their EHR. ($X^2(2)=3.54$, $p>.05$) These differences remain after controlling for 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, a better strategy includes focusing more explicitly on what constitutes best practice in use of the EHRs by nurses, and developing and evaluating competencies aligned with those best practices.

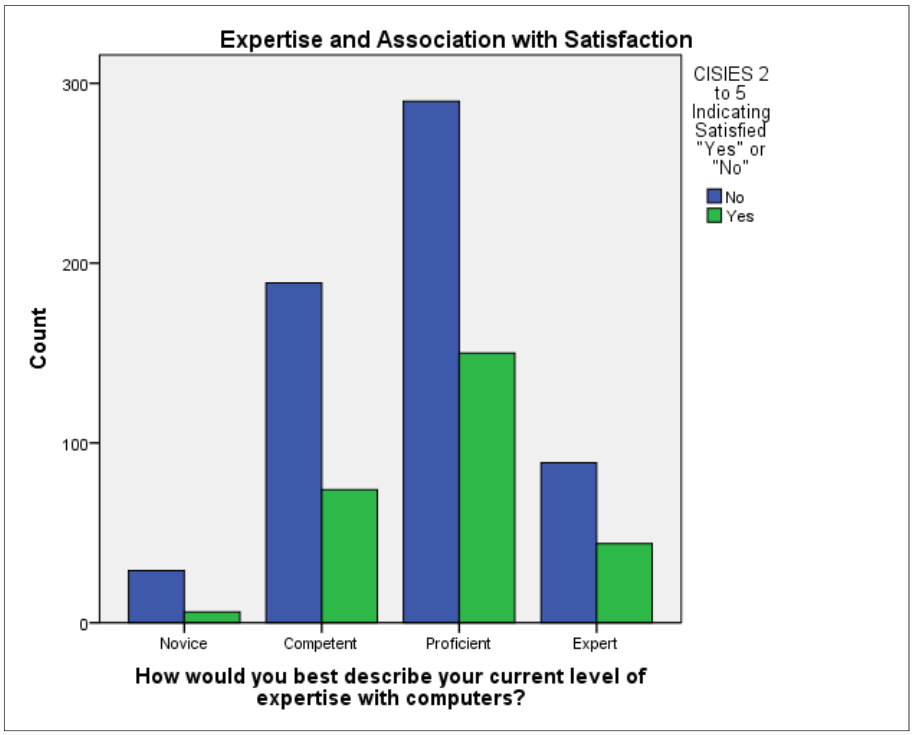


Figure 12: *Expertise in Computers related to satisfaction with the EHR*

Years in nursing and shift worked

When controlling for the EHR maturity, nurses were 42% more likely to be satisfied with their EHR when working nights, evenings and rotating shifts compared to those nurses working day shifts (OR1.423, 95% CI 1.019, 1.988).

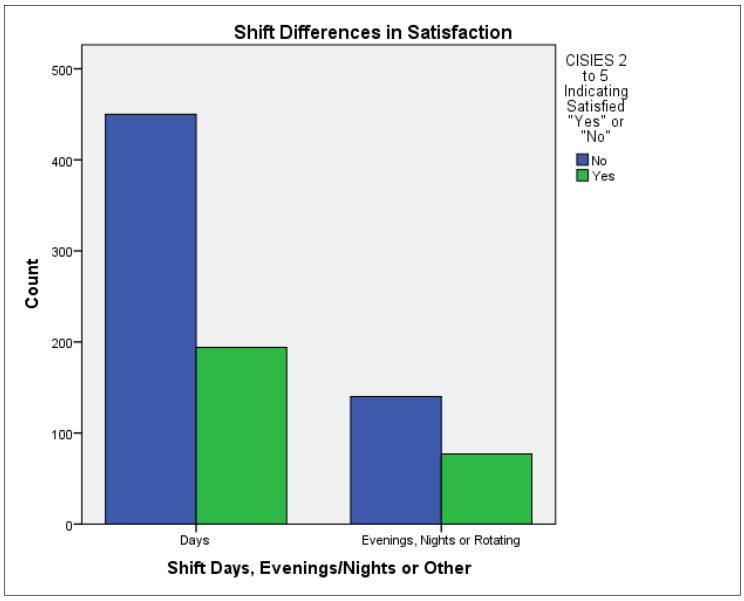


Figure 13: *Shift worked related to satisfaction with EHR.*

Nurses in practice for 6-10 years were 78% more likely to be satisfied with their EHRs, than other groups. There was no significant difference with respect to satisfaction among the other groups (OR 1.783; 95% CI 1.088, 2.923, *p*=.022). See Figure 14.

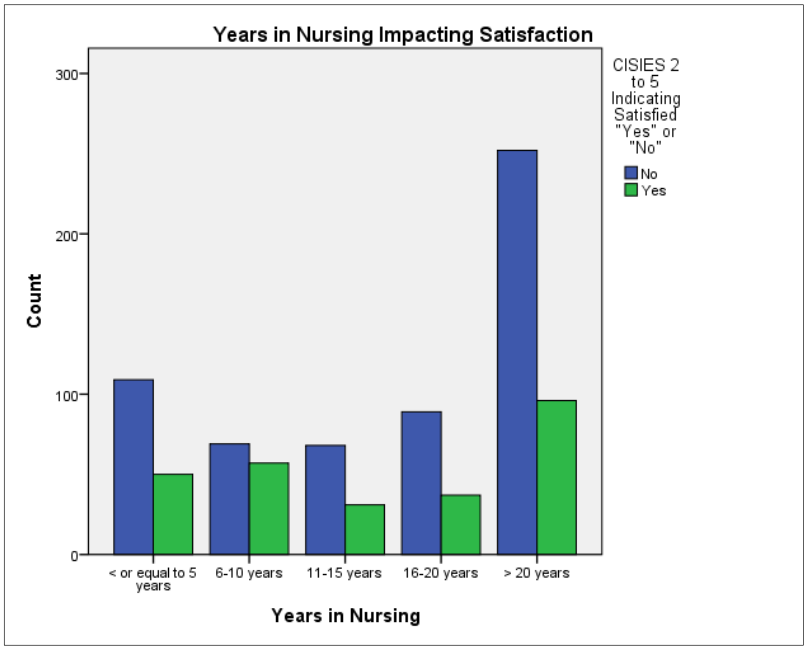


Figure 14: *Years in nursing related to satisfaction with EHR*

Age

When nurses 5–60 years of age were compared to nurses 18-25 years of age and the maturity of the EHR was controlled, older nurses were 36% less likely to be satisfied with their EHRs (OR .431, 95% CI .227, .817, *p*=.01). Nurses older than 61 years were 68% less likely to be satisfied with their EHR (OR .321, 95% CI .149, .690, *p*=.004). See Figure 15 for overall distribution of age related to satisfaction.

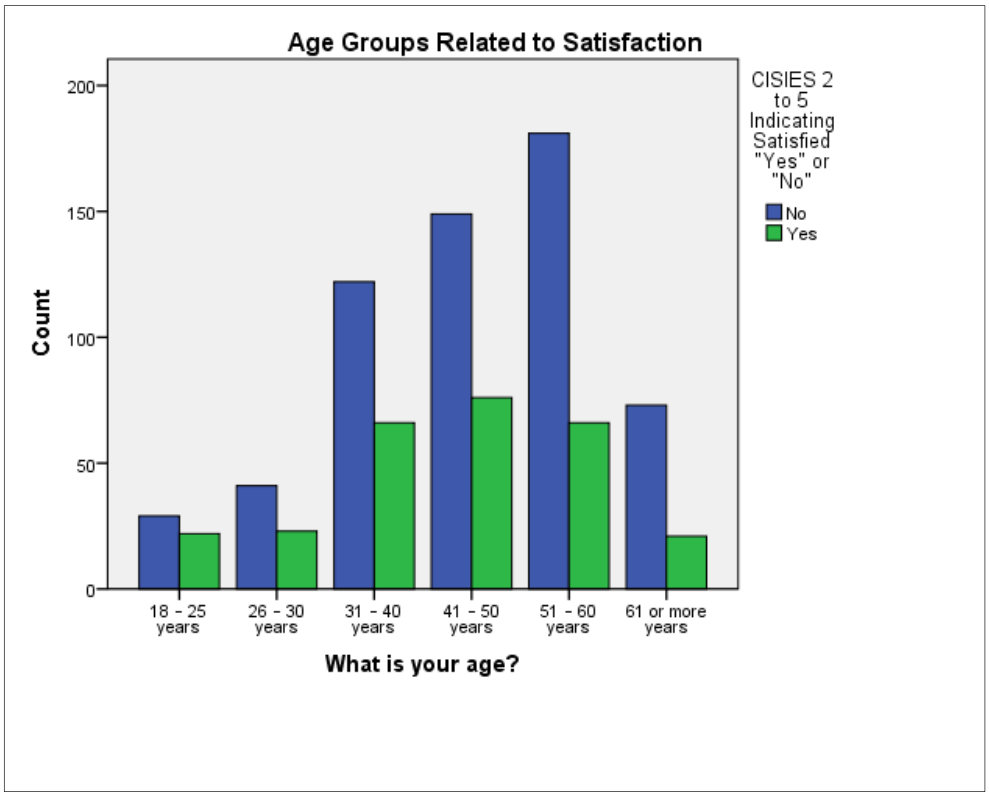


Figure 15: *Age related to satisfaction with EHR.*

Research Question 1.c.

What is the relationship between *CIS characteristics* and the nurses' perceptions of their CIS?

Satisfaction with EHR

The researchers then controlled for maturity of the system with the MUMSI to examine logistic regression models to further identify characteristics associated with satisfaction to support interventions to be recommended. When comparing differences in the actual clinical information system, EHR differences were apparent. The analysis examining differences comparing 95% CI of proportion reporting "yes" as satisfied indicates differences in EHR 2 and 3, as well as 3 and 9 in the error bar chart (Figure 16). However, once the maturity of the EHR is taken into account there was no significant difference in any of the EHRs reported. This finding places important emphasis on helping organizations reach meaningful use to improve the satisfaction of Texas nurses with their EHR.

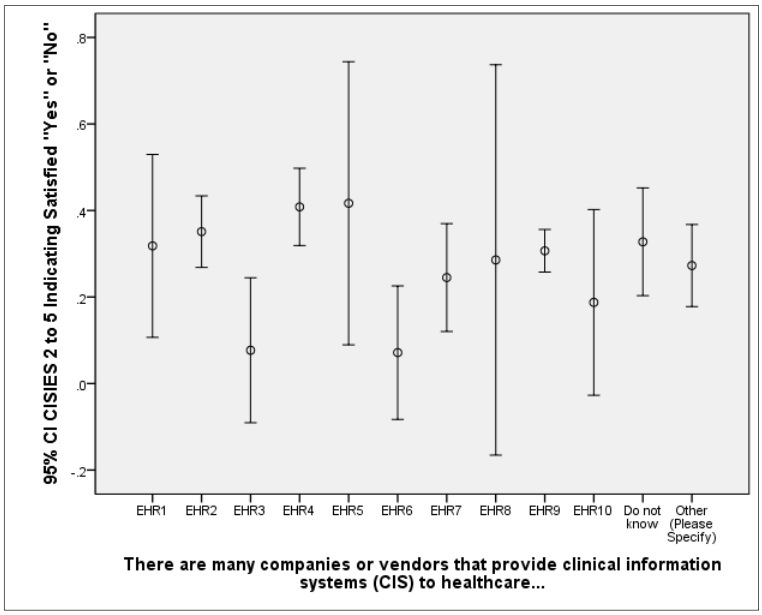


Figure 16. *Comparison of EHRs related to CISIES scores indicating proportion "Yes" 2-5 score of satisfaction*

Clinical decision support

The MU maturity index is comprised of a 24-item scale. The MU index can also be used to determine which of the MU elements appear to be associated with satisfaction of the EHR when controlling for demographic factors that influence the outcome. These findings can help to inform next steps for improvement strategies; for example, it was noted that clinical decision support for alerts and standards are significantly associated with nursing satisfaction. Nurses were 2.76 times more likely to be satisfied when these functions were present and used in the EHR when compared to nurses who indicated the functionality was not present (OR 2.758, 95% CI 1.666, 4.566). However, drug-allergy alerts were not as positive, with nurses 2.8 times more likely to be satisfied when these alerts ***are not present*** (OR 2.815, 95% CI 1.591, 4.981 p<.001). Additionally, it is notable that drug-drug interaction has similar findings with nurses 2.3 times more likely to be satisfied when this function is ***not present*** compared to present and used (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 clinical decision support that enhance nursing practice rather than detract from it. There may also be implications for usability, design and workflow improvements given these findings.

Other MU functionality associated with satisfaction

Other factors associated with satisfaction included electronic reconciliation of medications. When this functionality was present and used, nurses were 2.14 times more likely to be satisfied when compared to nurses indicating 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

when compared to some of the more straight forward functionalities and can require additional expenses charged by EHR vendors for gaining access to electronic pharmaceutical data to reconcile medications.

All other factors examined in a correlation matrix reflected some weak statistically significant associations between functionality to:

- capture and display demographic data (r=.142, p<.01),
- maintain an active list of patient problems and diagnoses (r=.121, p<.01),
- allow charting of vital signs (r=.10, p<.05),
- track hospital clinical quality data and yield rates of measures (r=.09, p<.05),
- create an electronic copy of patient's health information (r.08, p<.05),
- generates list of patients by specific conditions for quality measures (r=.10, p<.05),
- generates information regarding condition specific education materials (r=.11, p<.01),
- generates clinical care summaries (r=12, p<.01), and
- records patients responses to care electronically (r=.09, p<.05).

Another observation was that the additive effect of all of these factors combined with other factors influencing satisfaction, again compounds the importance of the collective impact of MU measures on nursing satisfaction. While there are several important stand-alone factors that are relevant to satisfaction, particularly clinical decision support, these findings would indicate MU at large is an important goal to achieve in order for nurses to be satisfied with their EHRs. Appendix B reflects the details on the correlation matrix. Those factors more highly correlated were examined within logistic regression models to examine the impact of the specific measure while holding the maturity of the EHR constant with the MU index.

Research Question 2 (Combined Analysis)

Combined quantitative and qualitative analysis was the approach used to address Research Question 2. Research question 2 was aimed at understanding the health IT education and practice needs of nurses using their EHRs. It was stated as:

What are the related core HIT competencies that should be covered in nursing education and in practice?

Answer to this question was based on results of Research Question 1 (quantitative analysis) and Research Question 3 (qualitative analysis). The research team utilized a mixed methods approach to inform specific findings to address the question of the competencies needed by nurses and all those involved in the implementation and use of EHRs.

Research Question 3 (Qualitative Analysis)

Qualitative analysis was the approach used to address Research Question 3. An open-ended item was

included in the online survey for this purpose. Research question 3 was aimed at understanding the personal experiences of nurses using their EHRs. The question was stated as:

What are the themes and sub-themes that emerge from the narrative comments (qualitative data) by nurses about using their EHRs that may inform improvement strategies?

In addition to completing the CISIES and demographic surveys, respondents were asked to provide feedback regarding the survey and to make additional comments about issues they considered important regarding the use of clinical information systems in their institutions. The question participants were asked to respond to was:
"We are interested in your feedback and anything we might not have covered, please provide any additional information you care to provide."
Of the surveys completed, 344 respondents provided free text or narrative responses. NVIVO word frequency analysis was done reflecting the information noted in Table 2. While this analysis detects key terms that can be easily dropped back into the quantitative data, this result did not fully inform improvement strategy so further analysis of the themes were needed.

Table 2: Word Count for Comments

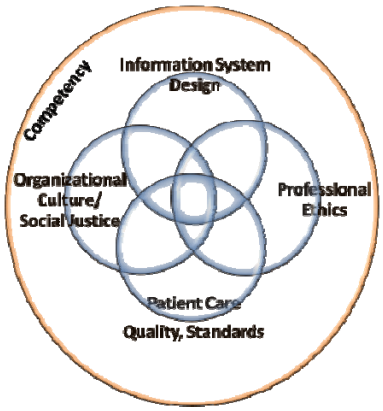
Theme	Word Count Frequency	Percentage
Electronic Medical Record	75	6.4%
Charting	65	5.5%
Nurses	42	3.6%
Information	52	4.4%
Computer System	189	16%
Software	110	9.3%
Patient	82	7.0%
Care	40	3.4%
Time	41	3.5%
Health	16	1.4%
Questions	23	2.0%
Healthcare	61	5.2%
Drugs	20	1.7%
Physicians	31	2.6%

Source:. NVIVO Word frequency distribution (Gilder, R. McBride, S. and Tietze, M., 2015)

Qualitative Narrative Content Analysis

A thematic content analysis of the nursing narrative in response to the open text question was used to analyze these data. The texts were organized in an excel file, read and reviewed systematically to identify key concepts by two qualitative researchers (Hanley, M. & Thomas, L., 2015). 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 was done and resulted in a synthesis of comments within the categories and revealed several primary themes noted in Figure 17. A conceptual model was developed by the research team that reflects the overall important concepts detected in the thematic analysis, also noted Figure 17.



Primary Theme with Sub-themes

- System design/usability
  - Interoperability
- Patient safety and quality
  - Documentation/legality
- Time
  - Nurse-patient time reduced/inefficient
- Support
  - IT, administrative, competency
- Workflow
  - Medication administration, work-arounds
- Distress
  - Aggravation, voice not heard
- Communication
  - Reduced consultation among clinicians

Figure 17. *Conceptual Framework for Qualitative Thematic Themes and associated subthemes from thematic analysis of nursing narrative*

Synthesis of Qualitative Findings

Nurses' narratives to the open-ended text question, when qualitatively analyzed indicated some positive experiences but commonly indicated issues with system performance and a distancing or separation of the nurse-patient relationship associated with the nurses' interactions with the EHR. Additionally, there was a noted dissonance or distress from a stated desire to practice to the best of the nurse's ability, and that the EHRs do not always align with that goal for nurses for various stated reasons noted above. As such, the research team and other content experts that reviewed these results in focus groups reflected that these qualitative findings can be supported by a model developed by Elsevier. (Figure 18). This model informs action steps in each quadrant of the model.

Within the qualitative data, negative early warning signs that present opportunity to improve the systems for nursing practice were detected. The polarity model notes that to address these early warning signals with issues such as design problems, lack of interoperability, negative impacts on quality and safety, measurable indicators are needed with timelines to address improvement.

The have positive results for dissemination and reinforcement in the state are of value with

respect to technology and practice. According to this action-oriented model, this warrants asking the questions*: "What? Who? By When?"*.

The findings from this EHR statewide study helps to inform our improvement strategies. The data supports identifying within regions those best practices and creating regional forums to communicate and share details with those areas that are exhibiting more challenges with these systems. Additionally, there are clear indications that the more mature the EHR was with respect to meaningful use measures, the more satisfied the nurses were with the system. This would emphasize a strategy to support statewide efforts to help organizations and regions achieve meaningful use, not only for the incentives and disincentives with the CMS EHR Incentive Program, but also on behalf of Texas nurses practicing safely and effectively to the best of their ability.

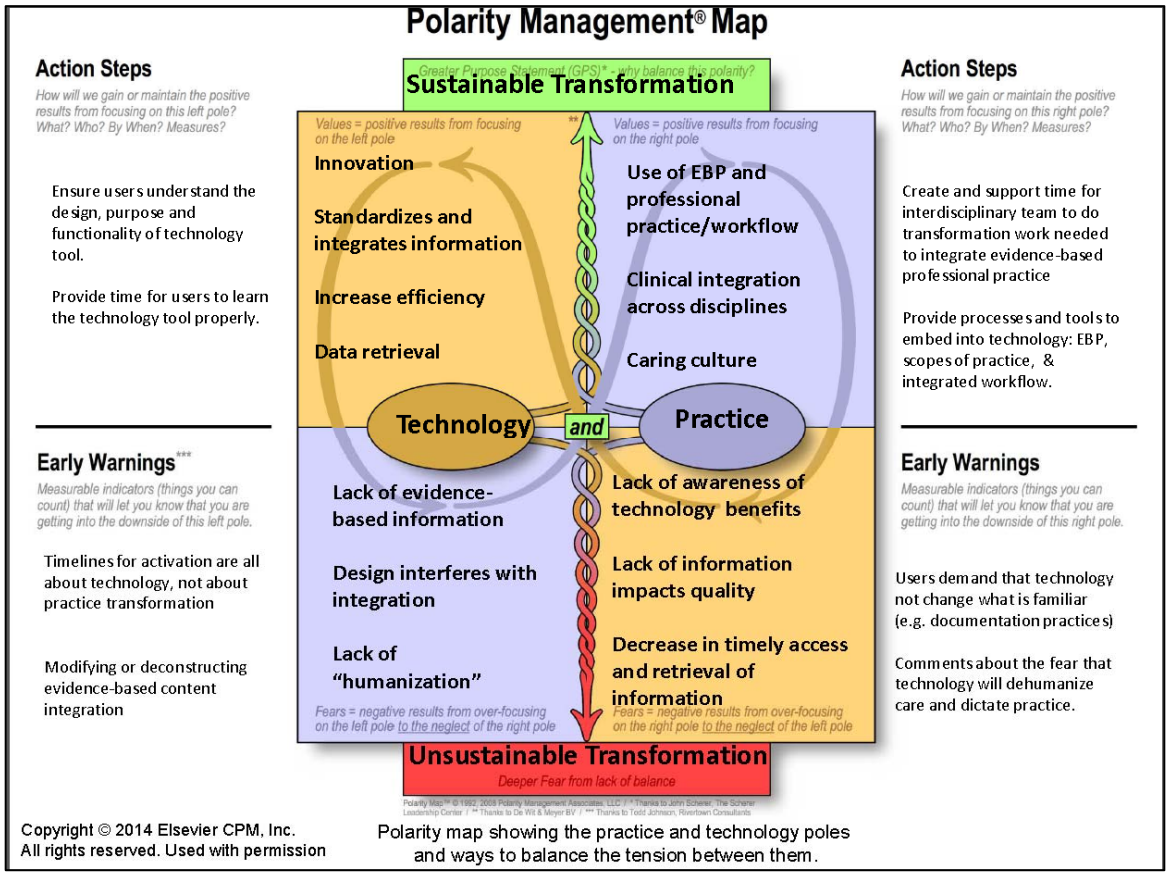


Figure 18. *Polarity Management Map. Source: Elsevier (2014) Pending permissions*

These data will be further analyzed to place the themes noted within the qualitative data to correlate the findings on the quantitative analysis with the results of the qualitative findings. Using this mixed

methods approach, the data can help to further inform improvement strategies within Texas. Examples of statement reflecting these themes are noted in Table 3.

Table 3: Sample Statements reflecting themes of open ended text question

"The particular EHR that our facility uses is very fragmented and inefficient. Additionally, not all of our physicians utilize the EHR; therefore, patient care is negatively impacted as one never knows if all of the information is in the actual EHR. There are too many areas that are of great concern for having a negative impact on Patient Safety."
"I implemented the current EHR here at our facility. The key to having a successful EHR is directly related to the investment the organization is willing to make. It is imperative that facilities implement high quality intuitive system that navigates users and does not distract users from their systematic way of thinking. CDS needs to be limited and in a separate section of the EHR and pop ups should be rarely used. Finally, HIT is vital in the success of future healthcare system. Nurse spend so much time playing historian and it could be prevented if systems could do a better job communicating. Privacy should not compromise patient safety."
"Yes, the documentation of "quality standards" has greatly improved, but patient care and patient safety has not. In fact nurses have to enter false information sometimes and work around the system (I use vendor X, Y and Z) and all have similar issues. I know firsthand of 2 sentinel events caused by the systems (X and Y). Also systems audits are being used to evaluate and discipline nurses; this is a big ethical issue as nurses are charting stuff for the wrong reasons/.....creating a conflict of interest"

Based on these very preliminary qualitative findings, we suggest proposed interventions such as those listed in Table 4.

Table 4: Relationship between Survey Themes/sub-Themes and Potential Action Items

Theme	Potential Action Items/Interventions
System design/usability	Utilize satisfied characteristics to improve dissatisfied & 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 health IT
Distress	Provide collegial approach, interprofessional solutions and openly monitor progress
Communication	Emphasize open, consistent, throughout organization

Recommendations

Gathering rich data from nurses and analyzing it in detail provided for the following significantly robust recommendations

- Convene a statewide meeting in Austin inviting academic and practice representatives from the region to report findings and develop tactical strategies to address the findings. Detailed reports by region can also be used to inform regional improvements.
- Work with the Rural Institutes, Regional Extension Centers, TORCH and other organizations to further support rural providers and healthcare organizations in achieving meaningful use and optimization of EHRs.
- Further investigation into the Clinical Decision Support findings to inform improvement strategies explicitly around usability, and design and strategies of CDS optimization for nursing.

- Establish a forum for regulators and stakeholders[4] to discuss policy initiatives regarding barriers to and solutions for use of EHRs. [re-emphasize the presentations available on the TNA HIT Web site as they provide much of the content needed for some of these issues].
- Engage executive leadership in Texas healthcare organizations through partnership with TONE and TNA to inform hospital leadership of findings and to strategize improvements to address communication and support based on quality improvement strategies.
- Communicate and convene with the Texas Team Executive Committee, and Practice and Education Committees to inform nursing leadership across Texas of findings and to solicit input into improvement strategies.
- Engage the Deans and Directors of the schools of nursing [and other interprofessional schools] for an open discussion of integrated informatics in curriculum.
- Timelines and next steps recommended are reflected in the Figure 19. Included in the timeline is formulation of interventions from October to December 2015 followed by deployment of interventions during the year 2016. A post-intervention survey to measure the impact of interventions on the satisfaction scores of the CISIES will be initiated in 2017. The outcome of the interventions aim to increase the CISIES satisfaction scores so that they reach into the 2-5 range by close of 2017.
- Engage other content experts across the nation including usability, informatics and TIGER leadership to inform improvement strategies on usability, system design, workflow, competency development and other important findings relevant to the study findings.
- Consider establishing a national strategy to invite other states to participate with Texas in collecting benchmark data with Texas taking a leadership role nationally in these efforts.

[4] Stakeholders include practice, administration, education and technology vendors/suppliers

Timeline

The timeline for the study and related interventions and dissemination are depicted in Figure 19. Extensive analysis has taken place during the summer and early fall of 2015 with report development and write-up of findings occurring in September 2015. The respective TNA and TONE Boards will review the report in October 2015 to begin the process of approving or reframing recommendations to inform the Texas improvement strategies. The Boards' recommendations will be taken into full TNA/TONE HIT Committee to work on detailed strategies in the final months of 2015. The kickoff for the execution of the final strategies will occur in early 2016 with a detailed project plan for the program of intervention to be designed by the full committee. The committee recommends to the Boards that by end of 2017 with findings to come in during 2018, a follow-up study be executed to determine the overall satisfaction of Texas nurses with use of EHRs.

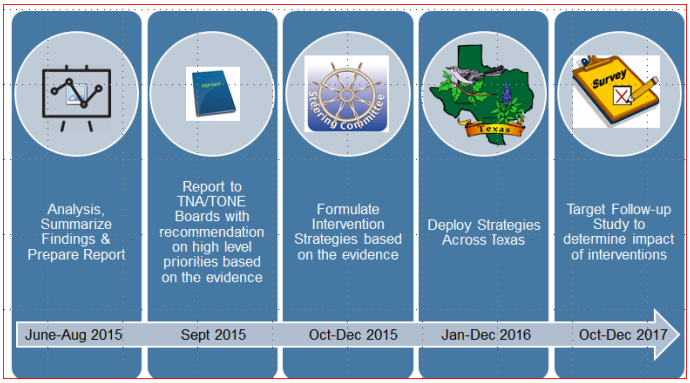


Figure 19: *Time line for completion of project.*

Conclusion

In conclusion, this report is the result of a study that has been a long standing project for the TNA/TONE HIT Committee originally conceptualized shortly 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 to fully execute the study (MUMSI). As a result, Texas is now is a unique position to help inform national strategies for improving EHRs and other point of care technology to optimize these systems for nurses practicing within interprofessional teams. Several states and individual organizations across the U.S. have indicated their interest in joining a more expansive national effort capitalizing on the foundation Texas has established with this effort.

Nurses play a critical role within interprofessional teams in helping to shape this technology for better patient care as is emphasized in the IOM Future of Nursing report (IOM, 201). 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 improvement of these systems on behalf of the 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 (2014) calls for innovative nurse leaders to step forward and help shape the use of technology to accomplish the Triple Aim of improving 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" (T.I.G.E.R, 2014, p. 4). Texas nurses stand poised to use these study findings to inform plans of action to lead transformational change.

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Appendix A

Years in Nursing Practice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 years	4	.4	.4	.4
	< 1 year	4	.4	.4	.8
	1-5 years	183	18.5	18.6	19.4
	6-10 years	141	14.3	14.3	33.8
	11-15 years	109	11.0	11.1	44.9
	16-20 years	139	14.1	14.1	59.0
	> 20 years	403	40.8	41.0	100.0
	Total	983	99.6	100.0	
Missing	System	4	.4		
Total		987	100.0		

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	86	8.7	8.7	8.7
	Female	898	91.0	91.3	100.0
	Total	984	99.7	100.0	
Missing	System	3	.3		
Total		987	100.0		

What is your race?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White/Caucasian	823	83.4	83.6	83.6
	Black/African American	55	5.6	5.6	89.1
	American Indian/Alaska Native	6	.6	.6	89.7
	Asian	53	5.4	5.4	95.1
	Native Hawaiian/Pacific Islander	1	.1	.1	95.2
	Other	47	4.8	4.8	100.0
	Total	985	99.8	100.0	
Missing	System	2	.2		
Total		987	100.0		

What is your ethnicity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hispanic or Latino	107	10.8	11.0	11.0
	Non-Hispanic or Latino	869	88.0	89.0	100.0
	Total	976	98.9	100.0	
Missing	System	11	1.1		
Total		987	100.0		

Do you provide direct patient care 50% of the time?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	674	68.3	68.3	68.3
	No	313	31.7	31.7	100.0
	Total	987	100.0	100.0	

How would you best characterize your position in the institution?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Staff	618	62.6	62.6	62.6
	Supervisor	60	6.1	6.1	68.7
	Manager	97	9.8	9.8	78.5
	Director	79	8.0	8.0	86.5
	Other (Please Specify)	133	13.5	13.5	100.0
	Total	987	100.0	100.0	

Which shift do you primarily work?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Days	736	74.6	74.6	74.6
	Nights	209	21.2	21.2	95.7
	Days/Nights Rotating	22	2.2	2.2	98.0
	Evenings	10	1.0	1.0	99.0
	Other (Please Specify)	10	1.0	1.0	100.0
	Total	987	100.0	100.0	

Please select one of the following that best describes your professional role

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Advanced Practice Nurse	34	3.4	3.4	3.4
	Certified Registered Nurse Anesthetist	10	1.0	1.0	4.5
	Care Assistant/Nursing Technician	4	.4	.4	4.9
	Clinical Nurse Specialist	25	2.5	2.5	7.4
	Licensed Practical Nurse	16	1.6	1.6	9.0
	Certified Nurse Midwife	3	.3	.3	9.3
	Registered Nurse	814	82.5	82.5	91.8
	Other (Please Specify)	81	8.2	8.2	100.0
	Total	987	100.0	100.0	

Appendix B

Correlations with CISIES 2-5 "yes" or "No"		
MU Measures	Pearson Correlation Sig. (2-tailed) N	CISIES 2 to 5 Indicating Satisfied "Yes" or "No"
01. Includes a computerized provider order system for directly entering medication orders	Pearson Correlation	.039
	Sig. (2-tailed)	.327
	N	621
02. Initiates alerts when a medication order results in a possible drug-drug interaction	Pearson Correlation	-.002
	Sig. (2-tailed)	.966
	N	621
03. Initiates alerts when a medication order results in a possible drug-allergy interaction	Pearson Correlation	-.007
	Sig. (2-tailed)	.870
	N	621
04. Captures and displays Demographic Data	Pearson Correlation	.142**
	Sig. (2-tailed)	.000
	N	621
05. Maintains an active list of patient problems and diagnoses	Pearson Correlation	.121**
	Sig. (2-tailed)	.002
	N	621
06. Maintains an active list of patient medications	Pearson Correlation	.056
	Sig. (2-tailed)	.163
	N	620
07. Maintains an active list of patient allergies	Pearson Correlation	.046
	Sig. (2-tailed)	.250
	N	621
08. Allows recording and charting of changes in vital signs	Pearson Correlation	.100*
	Sig. (2-tailed)	.013
	N	621
09. Initiates alerts for clinical decisions/standards	Pearson Correlation	.232**
	Sig. (2-tailed)	.000
	N	621

10. Tracks hospital clinical quality data to yield rates for measures such as Core Measures	Pearson Correlation	.094*
	Sig. (2-tailed)	.019
	N	621
11. Creates an electronic copy of patient health information	Pearson Correlation	.081*
	Sig. (2-tailed)	.043
	N	621
12. Electronically shares key clinical information with providers and other entities as authorized	Pearson Correlation	.074
	Sig. (2-tailed)	.064
	N	621
13. Captures and displays Advanced Directives for patients 65 years or older	Pearson Correlation	.003
	Sig. (2-tailed)	.948
	N	621
14. Captures and displays clinical lab test results	Pearson Correlation	-.002
	Sig. (2-tailed)	.961
	N	621
15. Generates lists of patients by specific conditions for quality improvement	Pearson Correlation	.098*
	Sig. (2-tailed)	.014
	N	621
16. Generates information regarding condition specific education information and resources for patients	Pearson Correlation	.108**
	Sig. (2-tailed)	.007
	N	620
17. Electronically reconciles patient medications	Pearson Correlation	.124**
	Sig. (2-tailed)	.002
	N	621
18. Electronically generates Clinical Care Summary for discharge or referrals	Pearson Correlation	.124**
	Sig. (2-tailed)	.002
	N	621
19. Electronically reports targeted information related to public health and disease prevention	Pearson Correlation	.077
	Sig. (2-tailed)	.056
	N	620
20. Electronically records patient assessment	Pearson Correlation	.066
	Sig. (2-tailed)	.103
	N	621

21. Electronically records patient care planning	Pearson Correlation	.052
	Sig. (2-tailed)	.194
	N	620
22. Electronically records patient responses to care	Pearson Correlation	.089*
	Sig. (2-tailed)	.027
	N	621
23. Electronically records medication administration	Pearson Correlation	.069
	Sig. (2-tailed)	.087
	N	620
24. Uses barcode to record medication administration	Pearson Correlation	.065
	Sig. (2-tailed)	.105
	N	621

**<.01 and * <.05