

AN EDUCATIONAL INTERVENTION TO IMPROVE REGISTERED NURSES'  
DATA QUALITY IN THE ELECTRONIC HEALTH RECORD

A DISSERTATION  
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY  
IN THE GRADUATE SCHOOL OF THE  
TEXAS WOMAN'S UNIVERSITY

COLLEGE OF NURSING

BY  
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DECEMBER 2018

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## DEDICATION

To my mother, Ioana Sandu, who has inspired me in so many ways in my life, this journey included! Thank you for believing in me! Rest in Peace, dearest Mami!

## ACKNOWLEDGMENTS

I would like to thank my father Nicolae Sandu; my brother and his wife Valentin and Elena Sandu; my niece, Ioana Maria Sandu; Mr. Gerardo Cortes; my best friend Susan Alderman, Ph.D., RN; Horia and Stela Popescu; my church family, especially Frs. James Shadid, Ephraim, Iulian, and Anitei; and all my friends for their encouragement, patience, and love during this journey.

I would like to acknowledge my dissertation committee Dr. Ann Malecha, Dissertation Chair, and committee members, Drs. Sandra Cesario and Karen Pancheri, who have led me down to this path with support and encouragement. I would like to add a special thank you to my advisor, Dr. Ann Malecha, Dissertation Chair. She believed in me and was my role model and pivotal in my success. I hope to carry out her outstanding nurse scientist legacy. I would also like to thank Dr. Lene Symes who guided me to find the scientific gap in this digital era and who taught me that perseverance is the key to success. I would also like to thank Dr. Judith McFarlane who challenged me to develop a strong research design, and the project's statistician, Dr. Wanyi Wang.

I am also indebted to Sigma Theta Tau International for awarding a research grant allowed me to finish my research.

## ABSTRACT

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### AN EDUCATIONAL INTERVENTION TO IMPROVE REGISTERED NURSES' DATA QUALITY IN ELECTRONIC HEALTH RECORDS

DECEMBER 2018

Electronic health records (EHRs) are essential for ensuring quality healthcare; therefore, their data quality is paramount. Exploring novel ideas to minimize errors in EHRs and early initiation of data quality (DQ) awareness may improve documentation quality. The main aim of this randomized 2-group, post-test study was to evaluate an educational intervention seeking to improve DQ in the EHRs of registered nurses (RNs). A sample of 154 RNs completed the study (experimental group  $n = 77$ , and attention control group  $n = 77$ ). The Accuracy, Completeness, Timeliness, and Objectivity for Registered Nurse's driven Data Quality (ACTO\_RNs DQ) theoretical model and grading tool was developed for the study. Cross tabulation computation using Chi-square and Cramer's V tests examined whether the DQ teaching intervention made a difference in accuracy, completeness, timeliness, and objectivity in EHR documentation. After the intervention, participants ( $N = 154$ ) who completed shift assessment entries using ACTO algorithm documentation indicated increased accuracy (59.7%), greater rates of completion (72.7%), timelier documentation (89.6 %) and more objectively documented records (53.2 %). Of interest, years of experience in nursing, experience with EHRs or experience with

MediTech did not contribute to significant differences in quality of electronic documentation.

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## CHAPTER I

### INTRODUCTION

Information technology is increasing rapidly and use of electronic health records (EHRs) to document patient information is an important vehicle for measuring the quality of healthcare (Esper & Walker, 2015; Susanto, 2017). In the technology-rich environment of healthcare, data quality (DQ) of EHRs is significantly related to reimbursement, patients' safety, and research outcomes. Patient documentation in the medical record is a fundamental element of clinical practice and serves as the basis for reimbursement and as the legal record in the event of litigation (Briggs, LaTour, Eichenwald, Oachs, & Watters, 2012). Also, measuring the impact of infection control policy and potential interventions are based on accurate and timely documentation (Cohen et al., 2011). While hospitals are making considerable investments in health information technology (Sharma, Chandrasekaran, Boyer, & McDermott, 2016), maintaining quality documentation in EHRs remains challenging due to multifactorial reasons, including missing information (Hansen & Fossum, 2016) and the need for correct vital signs recordings and real-time data (Dawson, King, & Grantham, 2013).

Data quality is becoming the main vector for effective decision making in healthcare, and the quality of healthcare is contingent on health information integrity and accuracy (American Health Information Management Association [AHIMA], 2012). However, the right components of DQ to use for the task at hand still need to be identified (Kerr, Norris & Stockdale, 2007). According to Arrowood et al. (2013), it is

imperative that DQ be addressed before data are routed to a health information–exchange database, especially when data are incomplete, untrustworthy, or redundant; data time sensitivity is important as well, because it enhances a patient’s safety, care quality, and compliance. Flood, Pollock, McDonald, and Davey (2016) remarked that the accuracy of public health data is vital when the hospital changes databases. Later, Flood, McDonald, Pollock, and Davey (2017) pointed out that constant validation of data is important, especially when the information in medical records is incomplete or inconsistent.

Flaws in nursing documentation continue to exist, and the accuracy of data is still deficient (Wang, Hailey, & Yu, 2011). A medical record should be a true reflection of the patient’s condition; accurately, completely, timely, and objectively reflected in nursing documentation (Wang et al., 2011; Wilbanks, Moss & Berner, 2013); and yet, no clear solutions have been found to guarantee DQ according to these aspects (Kruse, Goswamy, Raval, & Marawi, 2016).

Nurses in today’s workplace need to be equipped with skills that enable them to transfer patient data from bedside to electronic documentation accurately. Nurses should be more fully aware of the quality of the data they enter in the EHRs (Chang, Poynton, Gassert & Staggers, 2011). Records lacking information (Hansen & Fossum, 2016) or poor patient data could lead to low efficiency in data utilization, mistakes in making decisions (Cai & Zhu, 2015), and jeopardy to a patient’s life (Collins et al., 2013). Thus, to improve documentation and save lives, it is paramount to study the importance of DQ elements in EHRs and to determine how these can be carried out into the real world, from patient bedside to electronic documentation.

The purposes of this study were (1) to determine if inpatient staff RNs who receive a one-hour, in-class education session on the importance of DQ in EHRs will demonstrate greater DQ accuracy, completeness, timeliness, and objectivity (ACTO) compared to RNs who receive a one-hour, in-class education session regarding ethics in nursing (EiN) and (2) to compare the differences between years of nursing experience, experience with EHRs, and MediTech on ACTO in EHRs.

### **Problem of the Study**

Information integrity is paramount in healthcare. A poor EHR system design causes EHR-related errors and jeopardizes the integrity of the information in the EHR, leading to errors that endanger patient safety and decrease the quality of care. Vital signs must be documented promptly, accurately, and objectively, in a way that allows for intervention if the patient's condition deviates from the norm or deterioration in the patient's status is detected (Stevenson, Israelsson, Nilsson, Petersson & Bath, 2016). Inaccurate or omitted information can have negative consequences on the patient such as duplicative care or, in the case of medication administration, an overdose (Bowman, 2013). Error-provoking conditions with medication administration due to inadequate communication via written documentation have been pointed out (Keers, Williams, Cooke & Ashcroft, 2013). Last, because nursing documentation represents much more than simply a record of a patient's continuity of care, the timing of documentation is essential for EHRs (Laitinen, Kaunonen & Åstedt-Kurki, 2010).

Quality with nursing documentation is still cited as a concern. According to Bowman (2013) most nurses use EHRs improperly. Prideaux (2011) addressed the need

to meet recommended clinical standards and found that failure to meet them was related to poor-quality nursing care. Errors in EHRs were attributed to poor record-keeping practices by nurses, and a disregard of the importance of electronic documentation when compared to delivering hands-on nursing care (Kärkkäinen, Bondas, & Eriksson, 2005). Inaccuracy in electronic documentation was found in nurses' documentation of diagnoses and interventions (Paans, Sermeus, Nieweg, & van der Schans, 2010a). It has also been noted that often nurses do not document rationally and use good critical thinking when giving a written indication of the progress of the patient. As a result, maintaining accurate and legally prudent documentation among nurses is still a concern (Blair & Smith, 2012).

### **Rationale of the Study**

Findings from the literature have provided very limited insight into DQ and nursing-driven tasks and how to address documentation quality, indicating the need for further exploration of the nurse's role in the digital era (Elgin & Bergero, 2015). It has been suggested that there is a need for ongoing documentation optimization and improvements based on nurses' knowledge (Kruse et al., 2016). Also, data elements used for quality measurement need to be identified and prioritized for further empirical investigation (Chan, Fowles & Weiner, 2010).

Understanding electronic documentation as a practical combination between technical and clinical skills, which has time-motion sensitivity, will evoke new ways to support more effective electronic documentation practices (Mamykina, Vawdrey, Stetson, Zheng & Hripcsak, 2012). Hence, understanding the importance and impact of EHRs and the problems of their appropriate use is not enough. Nurses need to know all

aspects of DQ taxonomy at the most granular level and why DQ is important based on its taxonomy. Research studies showed that implementing an early initiation of an evidence-based DQ training program, based on national healthcare demands, may help to increase awareness among nursing professionals, improve documentation, and save lives.

### **Theoretical Framework**

In the last decade, societal interest in DQ has increased because information has become one of the critical resources guiding the quality of decisions and actions (Stvilia, Gasser, Twidale & Smith, 2007), including those in healthcare. According to Knight and Burn (2005), DQ, or information quality (IQ), is used as an interchangeable, multidimensional concept; is based on authors' paradigms; and has multiple dimensions.

The product and service performance model for information quality (PSP/IQ) (Lee, Strong, Kahn & Wang, 2002) served as a framework for this study and explained the importance of IQ, a term interchangeable with DQ, as well as addressing IQ dimensions. The model presents PSP in four quadrants, signifying the IQ qualities critical in improving decisions within an organization. The model contains multiple IQ dimensions (e.g., free of error, objective, accessible, believable, timely, and complete); data is consolidated into four categories as sound, dependable, useful, and usable data. The focus of the model is on product or service delivery within an organization and how quality is assessed; whether in terms of IQ specifications (e.g., accurate, complete, secure, etc.) or consumers' expectations (e.g., objective, accessible, understandable, etc.). The model can be used either by consumers (the RNs in this study) or by administrators (in any industry) depending, of course, on whether the information is used as a product or

a service. The PSP/IQ framework describes DQ from the viewpoint of the consumer and considers information to be an entity that is constantly changing (Lee et al., 2002).

A second framework, Stvilia et al's (2007) conceptual model of information quality measurements (CMIQM), also influenced this study as a knowledge resource; it guides developing information quality (IQ) measurement models for many different settings, including healthcare. The model consists of four categories: activity types, the source of problems, reference bases, and IQ taxonomy. IQ taxonomy consisted of 22 IQ dimensions, with the most pertinent to healthcare grouped as follows: (1) intrinsic attributes (e.g. accuracy, completeness, currency, etc.) that persist over time unless culture is changing (e.g. spelling mistakes, etc.); (2) rational attributes that measure the relation between information and aspect of its usage (e.g. redundancy, completeness, etc.); and (3) reputational attributes that measure the position of information in cultural/activity settings. Taxonomy of IQ dimensions is central to the framework and IQ attributes; quality of the information is assessed to assist the consumers in knowing how information is valid, accurate, precise, consistent, natural, complex, verifiable, etc.

Based on this theoretical model, when an activity type is identified, and a relevant IQ dimension is selected, the metrics and resources of IQ could be identified. Furthermore, the model also explains how DQ evolves over time. Overall, the two complementary models were selected because, together, they can be used to explore DQ in nursing-driven tasks.

The framework ultimately used to generate this study is based on the two parent models of Lee et al. (2002) and Stvilia et al. (2007). The framework contains four nurse-

driven dimensions: (1) accuracy, (2) completeness, (3) timeliness, and (4) objectivity; today's scientific literature these dimensions are cited as the most critical elements of DQ (Appendix A1). Based on a rigorous and pragmatic concept synthesis, a theoretical framework was developed by the principal investigator (PI): The Accuracy, Completeness, Timeliness, and Objectivity for Registered Nurse–Driven Data Quality (ACTO\_RNs\_DQ) Framework.

The ACTO\_RNs\_DQ addresses the aspects of the PSP/IQ model that are most specific to nursing documentation: accuracy, completeness, correctness, and timeliness. From the CMIQM model, the framework pulls the DQ's taxonomy, which consists of the four dimensions of accuracy, completeness, timeliness, and objectivity; this allows the PI to evaluate variances caused by these dimensions in a meaningful way, in terms of care at the bedside in the twenty-first century.

The ACTO\_RNs\_DQ model is a proposed model for nurse-driven DQ that characterizes the information documented in EHRs and contains measurable nursing-driven components based on the empirical data of a patient's state of health. The model supports this study design and the tool that assesses the quality of nursing documentation. In Appendix A2 the theory of the model illustrates the relationship of the study's variables. Operationalization of the ACTO\_RNs\_DQ algorithm is illustrated in Appendix B.

## **Assumptions**

In today's world, nurses are expected to deliver bedside care supported by evidence-based practices (Yost et al., 2014). Regardless of circumstances, nurses need to function using complex adaptive systems that require accuracy, completeness, timeliness, and objectivity in electronic documentation. Thus, the assumptions for this study were:

1. Accurate data in electronic health records is a component of safe patient care.
2. Complete documentation is a component of electronic data integrity that can assure quality and risk-free patient care (Wright et al., 2015).
3. Real-time electronic documentation enhances patients' safety (Nielsen, Peschel, & Burges, 2014)
4. An objectively recorded patient's state of health is related to population health (Richardsen et al., 2016)

## **Research Questions**

The following research questions were addressed in this study:

1. Are there differences in DQ accuracy, completeness, timeliness, and objectivity between inpatient staff RNs who receive a one-hour, in-class education session on the importance of DQ in EHRs and RNs who receive a one-hour, in-class education session regarding ethics in nursing (EiN)?
2. What are the relationships between years of nursing experience, experience with EHRs, and data quality accuracy, completeness, timeliness, and objectivity?

## **Definitions of Terms**

In this study, the dependent variables were accuracy, completeness, timeliness, and objectivity; the independent variable is the educational module on either DQ or EiN. The conceptual and operational definitions for the independent and dependent variables for this research study are listed below.

*Accuracy* was conceptually defined as the extent to which data are correct, reliable, and free of errors in describing the patient's state of health (Knight & Burn, 2005). For this study, accuracy was operationally defined using the ACTO\_RNs algorithm score. The researcher reviewed the patient's EHR for accuracy of the patient's blood pressure (BP) throughout a shift time. The nurse should verify the patient's BP in accordance with the patient's condition, ensuring that the BP was recorded and transmitted electronically from Allen-Welch monitors, and comment on the nursing notes that the BP or vital signs were acknowledged and verified. If the BP demonstrated fluctuations due to the patient's condition, the nurse should make a notation under nursing notes as well. Credit for accuracy was given to the nurse that made this statement each time the BP was recorded and at the end of the shift.

*Completeness* was conceptually defined as the extent to which information is not missing and is sufficient to describe the patient's state of health (Weiskopf, Hripcsak, Swaminathan, & Weng, 2013; Knight & Burn, 2005). For this study, completeness was operationally defined using the ACTO\_RNs algorithm score. The researcher reviewed all 19 shift-assessment fields, categories, and subcategories, ensuring all were filled out. All

19 fields were documented based on “with defined parameters (WDP)” criteria with a “Yes/No” option; the subcategories were documented based on the drop-down and comment menus. The researcher gave credit for completeness when the categories and subcategories were completed according to institutional guidelines or policy; if the subcategories were not recorded but explanation was given, credit was given as well; otherwise, no credit was applied.

*Timeliness* was conceptually defined as the extent to which information is sufficiently up-to-date for describing the patient’s state of health (Knight & Burn, 2005). For this study, timeliness was operationally defined using the ACTO\_RNs algorithm score. The researcher measured the number of hours in which the shift assessment was completed. Per institutional policy, the RN should do a shift assessment for each patient, and the assessment needs to be completed by the end of the shift. For this study, the participants were instructed to complete the shift assessment within four hours of receiving shift report. To evaluate timeliness, the researcher subtracted the time in minutes from the “recorded” field to “occurred” field. Credit was given to the nurse who completed the shift assessment within four hours or, if longer than four hours, provided an explanation. No credit was given otherwise.

*Objectivity* was conceptually defined as the extent to which information is rational, neutral, and not biased, in describing a patient’s state of health (Knight & Burn, 2005). Nursing scholars have described nursing clinical judgment as identifying pertinent and non-pertinent patient cues, developing interpretations, and responding through

nursing action (Tanner, 2006). For example, poor objectivity will lead to misinterpretation, which hinders nursing actions.

For this study, objectivity was operationally defined using the ACTO\_RNs algorithm score. Objectivity was measured by the occurrence, initiation, updating of nursing care plan (CP) intervention(s), and objectively written nursing notes. Thus, the researcher reviewed the patient EHR, looking at the nurse care plan and nursing notes. If the care plan (CP) was initiated and updated objectively, the researcher gave credit to the participant who initiated the CP, provided an objective explanation, and made objective nursing notes during the shift to address the patient's state of health. Overall, credit was given when the participant initiated, updated, and completed CP and nursing notes objectively. No credit was given otherwise.

*Years of experience* as a registered nurse was conceptually defined as a licensed registered nurse who has completed an approved professional nursing school, passed the board of nursing exam, and functions within federal, state and local laws' legal scope of practice (The Texas Board of Nursing, 2018). Years of experience was collected for this study using a self-reported demographic form, asking the participants to indicate the number of years they have been a RN.

*Experience with EHRs* was conceptually defined as the amount of time, in years, that this documentation tool has been used by the nurse (Lavin, Harper, & Barr, 2015). Experience with EHRs was collected for this study by a question on the demographic form, which asked the participants to document the number of years they have used electronic documentation.

## **Limitations**

The study had a few limitations. One was related to float-pool nursing assignments and the possibility of cross-unit communications. Due to work dynamics, it was possible that the nurses might have discussed this research. Another limitation of the study was the nurses' lack of previous experience with this type of investigation. Although the hospital was seeking to become a Magnet institution at the time of the study, the nurses' thoughts regarding research participation were in the incipient phase. A final limitation of the study was related to evidence-based clinical documentation (EBCD) events. In December 2017, the hospital launched an EBCD care plan (CP) initiative to enhance MediTech nursing documentation. During that time, each nurse attended an internet-based step-by-step CP training session. This additional hospital-wide training might have compromised the research and restricted the generalization of study results.

## **Summary**

Data quality (DQ) has a public health value (Chen, Hailey, Wang, & Yu, 2014) and it is well known, since Florence Nightingale, that nursing documentation is one of nursing's most important tasks. There is also the expectation of DQ, for use in the legal system by healthcare providers, and without exception, nurses should accurately present the care provided throughout electronic documentation (Gabr, 2010; McLane, & Turley, 2011). Therefore, the current experimental RCT research study was conducted to evaluate any changes in DQ in nursing documentation. The study evaluated the effectiveness of two education modules, DQ on accuracy, completeness, timeliness, and

objectivity in the electronic documentation. The treatment and attention-control interventions were intended to identify changes in nurses' behaviors, namely improved EHR documentation. Conceptual and operational definitions of the variables were discussed based on the ACTO\_RNs\_DQ framework with the assumptions based on scientific evidence, current gaps, and the study's limitations.

## CHAPTER II

### REVIEW OF LITERATURE

#### **Introduction**

First introduced in the 1970s, EHRs have streamlined access to the aggregate of patient clinical data (Safran et al., 2007). Moreover, the utility and availability of EHRs have increased. They have become a mechanism for assisting the transportability and quality of pertinent information (Lobach & Detmer, 2007). At the national level, much attention has focused on the use of EHRs for improved patient health outcomes (Kelley, Brandon, & Docherty, 2011), but the quality of patient databases and nurse-entered electronic data (eData) are still inaccurate.

Regardless of database format, paper or electronic, DQ should be “fit for use” for those who depend on it to make correct decisions (Herzog, Scheuren, & Winkler, 2007). EHRs need to focus on enhancing DQ, integrating collections of research data, and implementing data interoperability across the healthcare industry (Song, Liu, Abromitis, & Schleyer, 2013). Furthermore, documenting nursing assessments in EHRs, rather than in paper format, has improved the quality of documentation structure, content, and processes to improve patient care (Wang, Yu, & Hailey, 2013).

DQ is defined, based on scientific evidence, as a set of symbols, signs, or points that are safe, integral, actual, standardized, complete, valid, reliable, sufficient, consistent, and trustworthy; can be exchanged between providers; and are free of errors. DQ is a crucial element of EHRs that guides the daily care of patients. Therefore, the purpose of this

integrative systematic review was to identify the predominant factors that influence DQ entered in EHRs by the nursing professionals; DQ's effect on patient outcomes; and whether there was a relationship between nursing years of experience, experience with EHRs, and accuracy, completeness, timeliness, and objectivity in particular. A methodology recommended by Whittemore and Knafl (2005) will be used.

### **Identification of Problem**

Today, DQ entry is challenging due to the complexity of patient information (Coleman et al., 2015). A patient can suffer severe injury or death if crucial accurate data are omitted, or if incorrect data are documented in a chart (Paans, Sermeus, Nieweg, & Van der Schans, 2010b). Thus, focusing on DQ becomes the key to the safeguarding of information (Herzog et al., 2007). Also, the EHRs' software architects need to focus on enhancing DQ, integrating collections of research data throughout interoperables across the healthcare industry (Song et al., 2013).

The use of technology can endanger patients through incorrect documentation. In one recent survey, 89% of physicians indicated that they used the copy-and-paste function of the EHRs, and errors were made as a result of using this function (Hawryluk, 2016). Veterans Affairs reviews of medical records between 1993 and 2002 found that 9% of records included copied information, and 13% of the copied material was misleading or incorrect, which posed a significant risk to patients. (Hawryluk, 2016). These conditions indicate that the quality of patients' documentation is crucial to practicing safe patient care.

High-quality nursing documentation is often lacking, although the implementation of electronic documentation is expected to improve nursing documentation (Fossum, Ehnfors, Svensson, Hansen & Ehrenberg, 2013). Informatics researchers are concerned with flaws in the nursing documentation process and its effect on patients' outcomes. Electronic medical errors jeopardize patient safety and increase the risk of juridical liability (Raposo, 2015). Further research is needed for a better understanding of the factors influencing DQ in nursing documentation, whether DQ is related to experience with EHRs, and why data correctness is important to patient care.

This integrative review was based on two separate searches, one for four main variables, and a search for one covariate that might confound the research results. The four main variables of interest selected for this review were based on the variables found most frequently during article screening (Table 1): the accuracy, timelessness, completeness, and objectivity (ACTO) of the data. Objectivity was indirectly considered based on Lee, Strong, Kahn and Wang's 2002 product and service performance model for information quality (PSP/IQ); good documentation must always be objective. These four variables also have the greatest likelihood of improving patient outcomes. Also, a secondary variable of interest was added, a covariant (Table 2) experience: experience in practice and experience with EHRs documentation as related to DQ.

The sampling frame was based on a literature review of articles related to the healthcare domain and the nursing profession. Nursing informatics is a newly researched field; therefore, the sampling frame was based on articles published between January 2012 and April 2017. The time frame was determined as follows: (1) in 2005, the

Medical Subject Headings (MeSH) term “nursing informatics,” was introduced and identified as the field of information science that analyzes and disseminates data through computers, (2) in 2010, the MeSH term “EHRs” was introduced and defined as electronic channels that transmit pertinent information concerning a patient's illness across different providers and geographic locations, and (3) in 2016, the MeSH term data quality, was introduced, referring to the field that measures the scientific correctness of data (National Center for Biotechnology Information, 2016). To find the most current articles, the sampling frame was based on articles published between January 2005 and April 2017.

### **Aim**

Given the beneficial effects of quality information in our EHRs, the identification of nursing-driven DQ components and covariant factors is of high relevancy. Therefore, an integrated literature review was performed to review DQ in 21st-century healthcare. The aim was to investigate existing evidence regarding DQ in EHRs, with emphasis on nursing-driven DQ components, ACTO, and the potential relationship between the level of the nurse's experience and quality of data in EHRs.

### **Search Methods and Strategy**

The preferred reporting items for systematic reviews and meta-analyses (PRISMA) model reveals the search used in the integrative systematic review and the article selection process (The University of North Carolina Health Sciences Library (2015). The search began with the MeSH terms “documentation,” “data quality,” and “EHRs.” Due to the paucity of results, additional terms were added, including “nurses,” “accuracy,” “completeness,” “timeliness,” “objectivity,” “health records,” and

“experience.” However, it was evident from the preliminary search that there was insufficient literature regarding electronic DQ entered by nursing professionals; thus, the DQ search was extended to include all healthcare providers.

### **Study Design and Inquiry**

Due to the paucity of articles available on DQ in nursing documentation, this review investigated various articles that used qualitative, quantitative, and mixed-methods designs. Whittemore and Knafl’s (2005) strategies were used to identify, screen, and critique the articles.

### **Data Sources**

We conducted two searches, and for each search two major databases, PubMed and CINAHL, were used. The searches were limited to peer-reviewed articles. Selected articles were those articles included either a search term in the title, abstract, or keywords; were published in English; and involved human-based research. The first search yielded 112 articles (CINAHL,  $n = 17$ ; PubMed,  $n = 90$ ; and manual search,  $n = 5$ ). An overview of the first search results is presented in Figure 2.1. The search was conducted by reading the title and the abstract of each article. Fifty-five articles were excluded, and 56 were eligible for this review. However, after the articles were read, 46 of them were excluded because the DQ was limited to patients, quality assurance, management, coding, indexes, framework, instruments, workflow, quality assurance, or systematic reviews. Of the 112 articles from the initial search, 101 non-relevant articles and one duplicate article were excluded, resulting in 10 articles included in this review.

The second search was on education and experience, and an overview of the results is presented in Figure 2.2. With the same precautions as in the first search, the title and the abstract of each article were read. Three articles were excluded as unrelated to the topic of interest, and 37 were eligible for this review. However, after the articles were read, 36 of them were excluded because discussion of DQ was limited to innovation, barriers, challenges, perspectives, patients, EHRs adoption, or public health. Of the 43 articles from the initial search, 36 non-relevant articles were excluded, resulting in 9 articles included in this review.

### **Inclusion and Exclusion Criteria**

Included in this review were studies related to humans, in peer-reviewed journals, published from 2005 until December 2017; this was limited to primary research involving EHR documentation among all healthcare providers. Due to the paucity of empirical research articles, many different study designs were reviewed, including retrospective, cross-sectional, and observational studies; either with convenience samples or as cohort studies; with or without randomly selected samples. In addition, to increase the robustness of this integrative review, qualitative, quantitative, and mixed-methods studies were included. To achieve an overall evaluation of variables of interest, the mixed-methods studies incorporated both quantitative and qualitative appraisal reports (Polit & Beck, 2016). No DQ article was excluded; however, an overall quality score of the articles could not be determined due to the variety of research methodologies.

Articles were excluded from this review if the study designs were not guided by an identified methodological framework; were editorial publications and reposts, meta-

analyses or systematic reviews; unrelated to humans; published before 2012 (first search) or 2005 (second search); or related only to paper-based documentation. Finally, an updated literature search for this study was performed for articles from December 2017 to January 6, 2018, but no further articles were identified.

### **Data Evaluation**

The overall quality score of the included articles was difficult to determine due to significant variance in research methods described in the articles. Four of the criteria discussed by Whitemore and Knafl (2005) were selected to evaluate these articles: authenticity, quality, informational value, and the representativeness of primary sources among the articles. All 19 articles had novel content and were not over-researched. The methodological quality of the articles was appropriate; most of them had small or adequate sample sizes with appropriate settings and good research design.

The mixed-methods studies included ethnographic research, focus groups, and semi-structured interviews (see Table 2.1 and Table 2.2). The sample was comprised of cohort studies, randomly selected samples, convenient sampling, observational studies, focus groups, and snowball samples. Regarding informational value, all studies produced meaningful conclusions related to the impact of the DQ of information entered in EHRs, DQ components, and providers' experiences related to the quality of electronic documentation. Thus, this literature review expands the body of knowledge related to DQ. Finally, the 19 articles selected for this integrative literature

review were primary sources, had similar sites and sample sizes, and discussed DQ related to documentation and healthcare providers' concerns.

### **Data Extraction**

In accordance with the study objectives, the following data were extracted from the studies: accuracy, completeness, timeliness, and objectivity, as the most cited factors that influence DQ in EHRs; in addition, one of the most cited covariants, experience and its relation to quality documentation in EHRs, was included.

### **Data Analysis**

An integrative review assessment was used to analyze the data from primary sources. The articles selected were collated and tabulated under Tables 2.1 and 2.2. These studies were published from 2005 to 2017 and conducted across the world from Australia to Europe, USA, Canada, and South America; hence, around the world, DQ is a major factor in patient's care delivery, efficiency, and cost contained.

### **Results**

There were ten primary research articles included in this review, comprising three quantitative (Byrd et al., 2013; Spuhl et al., 2014; Wang et al., 2013), two observational (Förberg, Johansson, Ygge, Wallin & Ehrenberg, 2012; Inan & Dinç, 2013), two qualitative (Skyttberg, Vicente, Chen, Blomqvist & Koch, 2016; Wright et al., 2015) and three mixed-methods studies (Puttkammer et al., 2016; Sockolow, Bowles, Adelsberger, Chittams & Liao, 2014; Yeung, Lapinsky, Granton, Doran & Cafazzo, 2012). Three key variables were identified in the articles regarding DQ analysis of information entered in EHRs. The variables were defined as (1) accuracy, recording the correct information in

the patient chart; (2) completeness, finishing the entry of the patient's information in the electronic record; and (3) timeliness, recording the patient's information in a timely matter.

### **Accuracy**

Poor DQ was related to inaccurate documentation in three studies (Forberg et al., 2012; Inan et al., 2013; Puttkammer et al., 2016). Patient data were found to be inaccurate due to lack of a standardized language, duplicate notations, omitted information, inadequate training, lack of awareness regarding EHRs' functionalities, widely varied terminology used by healthcare providers, or failure to recall in detail the task that was performed at the patient bedside.

### **Completeness**

Poor DQ was related to incomplete documentation in six studies (Byrd et al., 2013; Forberg et al., 2012; Inan et al., 2013; Puttkammer et al., 2016; Spuhl et al., 2014; Wang et al., 2013). In addition, incomplete documentation was found to be a problem due to either disagreement between providers, lack of comprehension on what to document, lack of association between the narrative electronic notes and the fields that were built to be completed within the EHR chart, or deficient training or education.

### **Timeliness**

Poor DQ was also found to be related with the time factor in four studies (Inan et al., 2013; Puttkammer et al., 2016; Socklow et al., 2014; Wang et al., 2013). A patient's data were not entered on time either due to flaws with the nursing assessment, lack of a

standardized language, the gap between the time when the nurse was at the patient's bedside and the time when the task was documented, or due to inadequate training.

While all the studies emphasized the importance of good electronic documentation, none of the studies identified a DQ theoretical model. All studies identified some of the DQ components: Byrd et al. (2013) and Wang et al. (2013) discussed completeness and timeliness of data; Forberg et al. (2012) discussed accuracy and completeness; Puttkammer et al. (2016) and Inan et al. (2013) discussed accuracy, completeness, and timeliness of DQ; Sockolow et al. (2014) discussed timeliness; Skyttberg et al. (2016), Spuhl et al. (2014), and Wang et al. (2013) discussed completeness; and Yeung et al. (2012) discussed timeliness. Completeness and timeliness were improved in a cohort study (Byrd et al., 2013) after introducing a clinical-assessment tracking system, compared to a retrospective study (Wang et al., 2013) in which quality of nursing in electronic documentation, completeness, and timeliness scores were not improved.

### **Objectivity**

Due to the drop-down options system in EHRs, objectivity can be overlooked. Also, free field documentation requires nurses to objectively evaluate the patient and document how the care plan intervention is maintaining or promoting care. In one of the articles, documentation objectivity was mentioned regarding narrative notes; however, the need for objectivity was found to be ubiquitous, particularly for describing mental health status (Spuhl et al., 2014).

Skyttberg et al. (2016) and Yeung et al. (2012) identified the importance of quality of documentation regarding vital signs. Skyttberg et al. (2016) conducted a qualitative study that used semi-structured interviews in 16 emergency departments in Sweden, and Yeung et al. (2012) performed research in five general medicine, in-patient units at three tertiary-care hospitals in Toronto.

In relation to the variables of experience and education, all of the studies emphasized the importance of DQ in electronic documentation. One mixed-methods study (Puttkammer et al., 2016), two qualitative (Bramble et al., 2013; Dillon et al., 2017), and one retrospective study (Lee, 2005) found that the level of experience among healthcare providers is associated favorably with DQ. One quantitative study (Sanders, 2016) and one observational study (Inan & Dinç, 2013) found no association between DQ and healthcare providers' experiences. One qualitative study (Poe, 2011) indicated that peer coaches value building informatics knowledge in a coach training nursing program, and both Inan and Dinç (2013), in an observational study, and Sanders (2016), in a quantitative study, identified the importance of ongoing educational programs to increase awareness among providers and improve EHRs' accuracy. For one quantitative study (Gomes, Hash, Orsolini, Watkins, & Mazzoccoli, 2016), the researchers collected no demographic data from the participants; thus, they were unable to come to any conclusions regarding RN experiences in relation to high-quality electronic documentation.

In contrast, Wang et al. (2013) found that electronic systems did not perform better compared to paper documentation in terms of completeness and timeliness. In Inan

and Dinç (2013) study, the electronic records were found to be inadequate regarding completeness, correctness, and timeliness. According to Forberg et al. (2012), the accuracy and completeness of documentation on insertion of peripheral venous catheters could be considered a quality indicator in a patient's care. Inan and Dinç (2013) posited that inadequate accuracy and poor nursing records interfere with communication between providers.

Looking at DQ from a different angle, Sockolow et al. (2014) indicated that improved timeliness in electronic documentation could trigger an improvement with reimbursement. Overall, 10 of the primary articles emphasized at least one of the three main variables with completeness represented as the most discussed variable ( $n = 7$ ), followed by timeliness ( $n = 6$ ), and accuracy ( $n = 3$ ). Lastly, documentation's objectivity was only once mentioned in narrative notes and found to be ubiquitous when describing a patient's mental status condition (Spuhl et al., 2014).

Experience was identified as one of the factors that influence DQ analysis of data entered in the EHRs. Experience was described either as the number of years within the profession, i.e., novice or experienced healthcare provider, or by the number of years working with electronic documentation. Nine additional primary research articles were included in this review to examine the relationship between DQ and experience (Table 2.2).

The nine additional studies were as follows: three quantitative (Gomes, et al., 2016; Poe, Abbott & Pronovost, 2011; Sanders & DeVon, 2016), one observational study (Inan & Dinç, 2013), two qualitative studies (Bramble et al., 2013; Dillon et al., 2017),

one retrospective (Lee, Lee, Lin, & Chang, 2005), and two mixed-methods studies (Baillie, Chadwick, Mann, & Brooke-Read, 2013; Puttkammer et al., 2016). Although these nine studies revealed that experience is related to the quality of data in EHRs, interventions were very heterogeneous (Table 2.2).

There was no association between documentation and nursing demographics (Inan & Dinç, 2013) and no association between the quality of data collection regarding vital signs collection and the nurses who performed the task (Gomes et al., 2016) nor relationships between DQ and nurses' experience (Poe et al., 2011). All nine studies emphasized that although DQ is challenging (Baillie et al., 2013), education is needed on the importance of DQ in electronic documentation. Furthermore, patients' safety remains a concern, and differences in using EHRs due to clinical training exist between providers and nurses (Bramble et al., 2013).

In contrast, in one of the mixed methods articles (Puttkammer et al., 2016) and one of the qualitative studies (Bramble et al., 2013), a relationship was found between providers' experience and EHRs. Of note, Puttkammer et al.'s study (2016) was conducted in an urban hospital, compared with Bramble et al.'s (2013) study, which was conducted in a rural ambulatory center. Lastly, in a qualitative study, Dillon et al. (2017) found that primary care providers had more experience with EHRs and advanced care plans while the specialist providers expressed confusion about documenting advanced care plans. In contrast, Lee et al. (2005) determined that younger nurses with more education but less computer knowledge (novice) spent less time on the CP than older nurses.

Additional DQ challenges with documentation that affect the main variables included nurses forgetting to use EHR features designed to enhance documentation (Spuhl et al., 2014); lack of documentation standardization (Wang et al., 2013; Yeung et al., 2012); clinical disagreement between nurses and physicians (Bramble et al., 2013); technical issues, such as inconsistent power supply, computer security, server maintenance, software malfunction (Puttkammer et al., 2016); lack of understanding of the EHR system interfaces (Inan & Dinç, 2013); and poor electronic documentation processes (Spuhl et al., 2014). One study was different from the others in that Byrd et al. (2013) studied a new EHR, the Clinical Assessment Reporting, and Tracking (CART) system, and indicated its superiority for data completeness and timeliness compared to traditional electronic record systems.

This integrative review had a few limitations. In general, the studies showed great heterogeneity regarding research designs and methodology (qualitative,  $n = 5$ ; quantitative,  $n = 5$ ; and mixed methods,  $n = 5$ ). However, the studies did not offer any consensus on how the most cited DQ elements, ACTO, should be maintained in nursing shift-assessment documentation and its safety implications. One observational study (Inan & Dinç, 2013) indicated the need to emphasize the importance of documentation among nurses and record-keeping qualities through continuing education, and one retrospective quantitative study (Wang et al., 2013) highlighted the need to investigate the flaws within nursing documentation, but no conclusive solutions were determined. Hence, there is a limited understanding of the DQ components across healthcare practices

and little consistent guidance on how all four components can be integrated daily at the patient bedside.

Another limitation was the terminology. Not only were the terms “*data quality*” and “*data objectivity*” new terms in the field of informatics, but they were not easy terms to grasp. And although numerous relevant synonyms of the searched terms were used, some studies using different terms may have been overlooked. Lastly, this integrative review was limited to electronic documentation, and studies of paper documentation were not included. An exception was Wang et al. (2013), which discussed a comparison between paper-based and EHR documentation in a care plan in a study of care in homes for the elders. However, it may be informative to determine if different documentation formats experience similar problems or if these difficulties are related specifically to electronic nursing documentation.

### **Summary**

Expansion of patient data, in volume and diversity, makes creating a safer patient-centered healthcare system more necessary than ever before. Therefore, it is important for nursing professionals to understand and maintain accurate, complete, objective, and timely electronic patient information. Equally important is the need for nurses to use this knowledge to sustain a clinical practice free of errors. Based on this literature review, to improve EHRs, nurses must be able to articulate these critical components of nursing informatics and, thus, be empowered to improve direct patient care. There is still no consensus on whether the level of experience among healthcare providers or their experiences with EHRs is favorably associated with DQ.

A general literature search strategy was used and identified a limited number of acceptable studies to report on DQ and its components from the last five years and experience related to DQ from the last ten years; this denotes a lack of research in this field. We found positive effects of experience on DQ and three direct DQ components that demonstrated need for improvement in electronic documentations, such as accuracy, completeness, and timeliness. Most of the included studies support or at least partially support these findings. None of the studies had a rigorous design, such as a randomized control design, and none of the quantitative studies showed an effect sizes estimation or calculation.

Overall, moving forward, a better understanding of the concepts of DQ, the importance of each element, and how DQ can be achieved as a nursing function is necessary for patient care. Thus, conducting quantitative research studies with large samples in complex settings, such as intensive care units, with conducive DQ teaching interventions will likely improve DQ in EHRs, change nursing practices, and decrease mortality and morbidity. Additionally, to explore the value of these findings, another avenue to be explored in the future is the development of a DQ mental algorithm that will include the variables of interest identified in this review: ACTO.

Ensuring DQ in EHRs is paramount to improve patient safety practices and positive outcomes. The first step toward DQ must be the one suggested in a National Institute of Standards and Technology report: Create a standardized documentation language (Lowry et al., 2015). The question is, how to accomplish this vital goal?

Despite the undeniable benefits of EHRs, human errors with entering eData occur (Raposo, 2015). Safety and quality care cannot exist without eData being accurate, complete, objective, and entered in a timely matter. Thus, based on this integrative review, further research is warranted to enhance nursing electronic documentation, and this research must be guided by DQ's most cited components, ACTO. Last, we must investigate if there are relationships between levels of years of nursing experience, experience with EHRs, and data quality in terms of accuracy, completeness, timeliness, and objectivity.

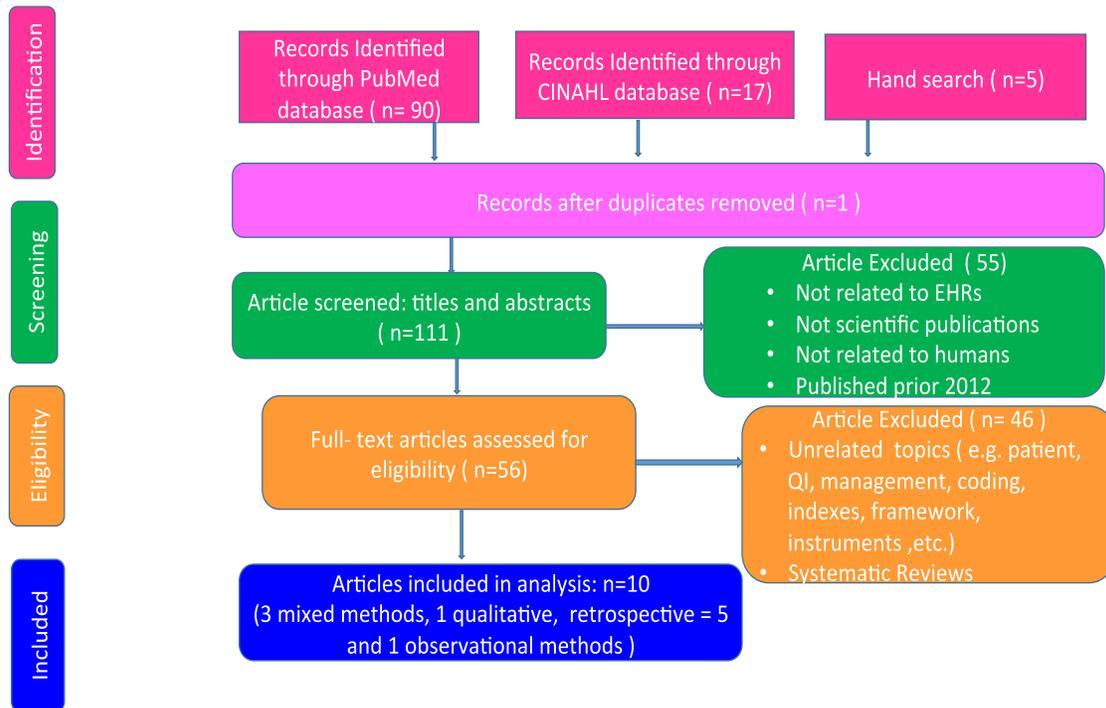


Figure PRISMA diagram of data quality: Question # 1

Figure 2.1. Prisma diagram of data quality study selection: question 1

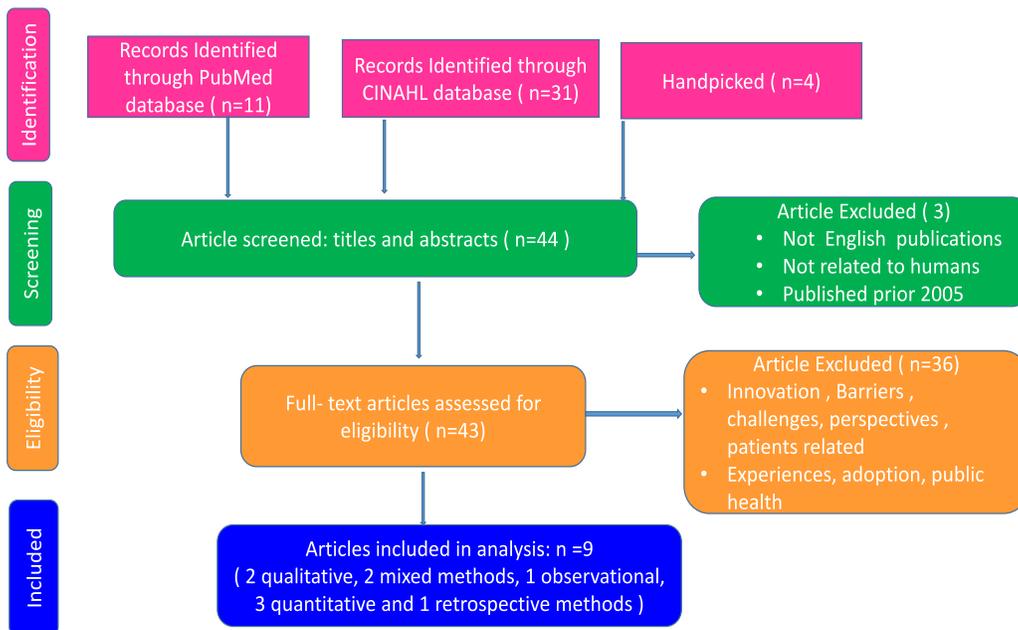


Figure PRISMA diagram of data quality: Question # 2

Figure 2.2. Prisma diagram of data quality study selection: question 2

Table 2.1.

*Summary of Integrative Review Findings: Aim 1*

<b>Author</b>	<b>Purpose</b>	<b>Sample/</b>	<b>Research</b>	<b>Methods/ Analysis</b>	<b>Findings</b>	<b>Recommendations</b>
<b>Year</b>		<b>Setting</b>	<b>Design</b>			
Byrd et al., (2013)	To evaluate the data validity, completeness, and timeliness of the Clinical Assessment Reporting and Tracking (CART) system compared to EHRs.	<i>N</i> = 200 Procedures/ The Department of Veteran Affairs (VA) USA	Quantitative	Ten randomly selected centers  Retrospective study  1,664 CART program observations compared to VA EHRs data.  Data validity & completeness percentages: chi-square; data timeliness: Kaplan-Meier curves  CART program better than prior system (79% vs. 63.1%, <i>p</i> < .001).	CART program generates excellent data validity for providers due to its superiority of data completeness and timeliness. The CART program generates superior DQ and better cardiac care for patients.	After the CART Program, 21% of key data elements remained incomplete.  Continuing efforts to improve full data capture in the CART is needed  Insufficient data quality appears to contribute significantly to multiple gaps (e.g., quality measure reporting, safety monitoring, and clinical decision support).

Förberg, Johansson, Ygge, Wallin & Ehrenberg (2012)	To compare the accuracy and completeness in peripheral venous catheter recordings before and after implementing a template in the electronic patient record	<i>N</i> = 14 wards/  Large pediatric university hospital in Sweden	Observation	PVCs patient audit retrospective Before and after intervention  Recorded audits before and then four and ten months after the introduction of a template  Descriptive statistics Chi-square test or Fisher's exact	EHRs did not provide accurate data on PVCs  Post intervention: increase in the recording of side ( <i>p</i> = 0. 006) and size ( <i>p</i> = 0. 022) ten months after the intervention.  Incomplete documentation: one of the 22 complications signs or symptoms observed before the intervention was documented; none of the complications ( <i>n</i> = 17 and <i>n</i> = 9) documented after intervention	Implications for practice: If the accuracy and completeness in the recording of PVCs is improved, it's feasible to use PVCs as a quality indicator
Puttkammer et al., (2016)	To describe levels of DQ for each indicator over time, completeness, timeliness, and accuracy included,	<i>N</i> = 20 Hospital in Haiti	Mixed-methods	Retrospective Interviews  Delphi process Covariates /Percentages Focus groups	DQ analysis examined 13 indicators for completeness, accuracy, and timeliness of data	Further effort is needed to systematize DQ approaches in this healthcare facility

	and identify the strengths, limitations, and strategies for strengthening DQ in EMRs			Retrospective quantitative analysis on the prioritized data elements Timeliness: 60% of the encounters entered three days post discharge.  Incompleteness was high (TB status – 20-35%; pregnancy status and ART eligibility 35-49%). Accuracy: age was inaccurate, flagged or suspicious in 26% of registration forms	Completeness of data for clinical follow-up needs improvement  Certain DQ indicators, completeness of height and TB status; accuracy of age, male sex, ART dispensation data, and visit dates; and timeliness of data entry improved with time.	
Inan & Dinç (2013)	To evaluate the quality of nurses' general record-keeping practice.	<i>N</i> = 98 nurses six intensive care units/ Teaching hospital in Turkey	Observation	Convenience Sample  Descriptive study  Structured observational and nursing audit records Developed an instrument that	The consistency between actual patient hygienic care and its documentation was 77.6%.  The qualities of nursing records were poor in terms of completeness, correctness, and timeliness, and were	Need more emphasis on the importance of documentation and record keeping qualities in nursing practice, nursing education and continuing education

				<p>consisted of questions about nurses' demographics and a structured observation form</p> <p>Descriptive statistics; Fisher exact chi-square test</p>	<p>inadequate for reflecting individualized nursing care and patients' involvement in their care.</p> <p>Poor documentation threatens patient safety.</p> <p>Inadequate and poor quality nursing records are not a communication tool between providers</p>
<p>Skyttberg, Vicente, Chen, Blomqvist &amp; Koch (2016)</p>	<p>To explore the factors affecting vital sign data quality</p> <p>To determine to what extent clinicians, perceive vital sign data to be fit for use in clinical decision support systems</p> <p>To provide recommendations</p>	<p><i>N</i> = 16</p> <p>Emergency departments (EDs) in Sweden</p>	<p>Qualitative</p>	<p>Semi-structured interviews, observations, and analysis of documentation templates</p> <p>Interviews were voice recorded, performed either on-site or by telephone</p> <p>Consensus between participants and</p>	<p>Themes: care process (e.g. standardized process, management, competence, knowledge information technology (e.g. work flow support documentation, interoperability, completeness)</p> <p>Need to confirm the results regarding vital sign data quality in EDs, with completeness as a special interest</p>

	on how to improve vital sign data quality			Saturation reached		
Spuhl et al. (2014)	To determine the concordance between providers on documenting delirium in the patient's electronic health records (EHRs) in a Veterans Affairs system	<i>N</i> = 30 Hospital USA	Quantitative	Randomly selected  Cohort  Retrospective  Kappa coefficient	Poor data quality in EHRs related to patients' poor outcomes.  Differences were found in the narrative and in the narrative notes, the ubiquity of mental status evaluations led to the detection of acute episodes of delirium  There was a weak relationship between structured and narrative data in EHRs, which suggested that the clinicians forgot the features available in the EHRs and documentation was incomplete  Low Kappa coefficient ( <i>k</i> = 0.33)	Future studies are needed to determine if similar patterns exist at other healthcare institutions and with other diseases and diagnoses.

Wang, Yu & Hailey (2013)	To understand nursing documentation and describe the effect of the electronic systems on quality of nursing documentation and data	<i>N1</i> = 159 paper-based and <i>N2</i> =249 electronic resident records/ Australia	Quantitative	Retrospective nursing documentation audit  Seven criteria were developed to measure and compare the quality attributes  The non-parametric Mann–Whitney <i>U</i>  Descriptive statistics	Statistically significant increase in the mean comprehensiveness rate of assessment documentation in the electronic systems in comparison with the paper-based system (0.66 vs. 0.58, <i>p</i> = 0.001).  Scores for the completeness of ongoing assessment forms and timeliness of documentation of admission assessment forms were lower in the electronic than in the paper-based systems ( <i>p</i> = 0.00 Electronic systems did not perform better than paper related to completeness and timelines of documentation.	Need to investigate factors that cause flaws in the nursing assessment documentation such as incomplete and delayed documentation, and its impact on quality of care
Wright et al., (2015)	To assess problem list completeness using an objective	<i>N</i> = 10/ Multisite	Qualitative	Retrospective	Six themes: Financial inactivity, Problem-oriented charting	Organizations should look to improve

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<p>measure across a range of sites, and to identify success factors for problem list completeness</p>	<p>healthcare organizations USA, UK, Argentina</p>	<p>Three approaches to study problem list, completeness for diabetes, and hemoglobin A1c (HbA1c)</p>	<p>(completeness across the ten sites ranged from 60.2% to 99.4%, with a mean of 78.2%), gap reporting, shared responsibility links to billing, and culture</p>	<p>problem with completeness.</p>
		<p>Interviews were conducted by phone or email depending on the availability of the interviewee.</p>		
		<p>Open-ended approach to learning about how the sites assessed problem-list usage</p>		

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Table 2.2.

*Summary of Integrative Review Findings: Aim 2*

<b>Author</b>	<b>Purpose</b>	<b>Sample/</b>	<b>Research</b>	<b>Methods/ Analysis</b>	<b>Findings</b>	<b>Recommendations</b>
<b>Year</b>		<b>Setting</b>	<b>Design</b>			
Puttkammer et al., (2016)	To describe levels of DQ for each indicator over time, completeness, timeliness, and accuracy.	N = 20 encounter types/ Hospital Haiti	Mixed-methods	Retrospective Interviews  Delphi process Covariates /Percentages Focus groups Retrospective quantitative analysis of the prioritized data elements Timeliness: 60% of the encounters entered three days post discharge.  Incompleteness was high (TB status, 20-35%; pregnancy status and ART eligibility, 35-49%).  Accuracy: Age was inaccurate, flagged or	DQ analysis examined 13 indicators for completeness, accuracy, and timeliness of data.  The evidence supports the hypothesis: Both greater healthcare facilities (HCF)-level experience and greater system-level maturity would be associated with favorable DQ.	Temporal factors helped in some areas of DQ but not in others suggesting that HCF experience should be reinforced with training and technical assistance, so that sub-optimal practices, interpretations, or workarounds do not become entrenched with experience.

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				suspicious in 26% of registration forms		
Inan & Dinç (2013)	To evaluate the quality of nurses' general record keeping practice.	<i>N</i> = 98 six intensives care units/ Teaching hospital in Turkey	Observation	<p>Convenience Sample</p> <p>Descriptive study</p> <p>Structured observational and nursing audit records.</p> <p>Developed an instrument that consisted of questions about nurses' demographics and a structured observation form</p> <p>Descriptive statistics; Fisher exact chi-square test</p>	<p>Frequency of documentation among nurses working up to 5 years was higher than those with other years of clinical experience (<math>p &lt; 0.05</math>).</p> <p>No association between the documentation and nurses' demographical variables (<math>p &gt; 0.05</math>).</p> <p>Although over time all nurses became accustomed to the experience, there was a likelihood that nurse behaved as the observer would like it, and some nurses might have performed and recorded with more hygienic care than they did previously.</p>	<p>More emphasis is needed on the importance of documentation and record keeping qualities in nursing practice, nursing education and continuing education</p>

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Baillie, Chadwick, Mann & Brooke-Read (2013)	Investigate student nurses' and midwives' experience learning EHRs	<i>N</i> = 215 nurses/UK Hospital	Mixed Methods	Questionnaire Pre/post training Focus groups Descriptive statistics	Mentors concerned regarding data entries of midwifery students in EHRs  The learning experience of accessing and using EHRs is challenging  Themes: (1) prepare for using EHRs and skills development; (2) access and involvement	Need formalized training
Bramble et al., (2013)	To identify and describe safety improvements and concerns indicated by providers and nurses using EHRs with eRx	<i>N</i> =16/ USA rural center	Qualitative	Two focus groups	Experiences between providers and nurses vary  There are differences in using EHRs between providers and nurses due to clinical training  Regardless of who was using the EHRs, patient safety concerns remain even with the use of EHRs with eRx	Future studies should include other health care providers (e.g., pharmacists), as well as patients)

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					The providers are viewed as being experts and nurses as novices in EHR use	
Dillon et al., (2017)	To understand how specialists and PCP incorporate advance care plan (ACP) in clinical EHR	<i>N</i> = 13 Providers/ California USA	Qualitative	Structured Interviews  Snowball sampling  Atlas.ti version  Transcripts use 4 coders to organize and code data.  77.8% agreement among 4 coders	Specialists expressed more confusion about documenting ACP, whereas PCPs reported standard clinic workflows  PCPs have experience with EHRs/ACPs, and specialists are novices because they are seeking only for one body system	Need to improve interoperability between hospital and outpatient EHR systems  Need a standardized clinic workflow for ACP.
Gomes, Hash, Orsolini, Watkins & Mazzoccoli (2016)	Determine the effects of implementing an EHRs on medical-surgical RN's activities,	<i>N</i> = 81 Four hospitals in two USA states	Quantitative	Purposive sample Survey 5-point Likert scale, ranging from very bad to very good.  30-minute in-services face-to-face on study units EHR training	A significant difference was found between diploma graduate nurses' and associates degree nurses' intensions in using EHRs ( $t = 2.56, p = .01$ ).  Diploma- and associate-prepared nurses were	Need more mixed-method studies to determine factors related to EHR deployment  Sample size should be increased to reduce the chance of bias.

				Independent-samples <i>t</i> -test - evaluate whether attitudes and beliefs about EHRs differ based upon nurses' educational level	less positive about EHRs than baccalaureate-prepared nurses  A significant difference in belief between nurses with less than 15 years' experience and nurses with more than 15 years' experience ( $p = .01$ ),  Possibly nurses with less experience were more agreeable to the use of the technology	
Poe, Abbott & Pronovost (2011)	To evaluate the effectiveness of peer coaches in increasing learner satisfaction with EHRs use	$N = 221$ nurses/ USA academic medical center	Quantitative Non-experimental with before and after measures  Survey designed to be administered before and after implementation	Nonexperimental with before-after measures  Survey designed to be administered before and after implementation  Questions: a 6-point Likert scale ranging from 1 to 6.  Perception of data by using the Clinical Information	Staff nurses were moderately satisfied with: (1) the adequacy of coach-enhanced training during implementation (2) experiences & support with coach-training learning program.	Needs analysis on EHRs use to increase in US healthcare delivery efficiency and reduce errors  Learning through continue education is needed on efficiency and errors reduction in EHRs

				System Implementation Evaluation Scale (CISIES)- Cronbach Alpha = 0.94 and construct validity	Peer coaches used to begin building informatics knowledge and skills	
				Survey has 37-items		
Lee, Lee, Lin & Chang (2005).	To test a model of factors influencing the efficient use of a computerized nursing care planning (CNCP) model	N = 612 Nurses/ Hospital Taiwan	Retrospective Dependent variables (DV): age, education level, nursing experience	Correlation and binary logistic regression analyses used to explore the relationships between (1) demographics, computer experience variables and technology factors, and (2) to predict the efficiency of computer use  Factor professionalism had no statistical significance in either the correlation or regression analyses subcategory ( $\alpha = 0.42$ ).	Younger nurses with more education, less computer knowledge, more education/training and usability, spent less time on care plan.  Older nurses have less nursing education & might lack nursing knowledge and skills in writing care plans significantly correlated with daily use of the CNCP was education/training ( $r = - 0.4$ ; $p = 0.0000$ ) Factors that influence computer uses and healthcare outcomes vary	Need to seek out technology and immediately give data for decision-making to clinicians

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					based on age, experience, etc.	
Sanders & DeVon. (2016)	To explore the relationship between patient and nurse characteristics and accuracy of triage in AMI patients	<i>N</i> = 286 patient records in EDs/ Two hospitals USA	Quantitative	Retrospective, descriptive study  Convenience sample  Power analysis = 112 patients for a medium effect size, and an $\alpha$ of less than 0.05 with a power of 0.80  Descriptive statistics Frequencies and percentages Cross tabulation procedures between cases with Pearson's correlations and logistic regression	The age of the emergency nurse was a predictor of accuracy in triage  The older the emergency nurse, the greater the likelihood that the triage level designation was accurate  Neither level of education nor years of experience predicted accuracy of triage level designation	Strategies that will improve accuracy should be explored and implemented, such as targeted educational interventions aimed at increasing awareness of AMI multisymptomatic presentations.  Little evidence of correlation between years of experience with ERHs and accuracy in triage

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## CHAPTER III

### METHODOLOGY

Given the difficulty of controlling conditions, randomized control studies (RCTs) are the gold standard in research. RCTs are the highest class of evidence-based methodologies, comparing the outcomes of an intervention group to a control group with evidence based on the effect on the intervention group (de Jong, Schout & Abma, 2015). These studies use rigorous methodological procedures, and the researchers are active agents (Polit & Beck, 2016).

In this context, this study used an experimental randomized 2-group design to evaluate if inpatient staff RNs who received a one-hour class on the importance of DQ in EHRs (intervention group) demonstrated a difference in accuracy, completeness, timeliness, and objectivity in EHR documentation compared to inpatient staff RNs who did not receive DQ training (attention control group).

The groups were composed of RNs working on medical surgical units (MSUs) and critical care units (CCUs) who underwent either one hour of DQ training or one hour of EiN training. The medical and surgical units were in various buildings and floors throughout the institution. The researcher, the study's PI, presented the in-class education lectures. To add rigor to the study, a randomization method was chosen (Polit & Beck, 2016). The randomization scheme was

a coin toss to select the units receiving the experimental intervention. Randomization was based on the units' location.

### **Setting**

The study setting was a suburban inpatient hospital, part of a network system, in a Texas metropolitan area. The hospital had a total of 630 staffed beds, 28,681 total discharges, and employed 2,000 staff members (American Hospital Directory, 2018). The study was conducted at the hospital on 16 nursing wards, MSUs and CCUs. The recruiting process was conducted throughout the nurses' workday and before the teaching interventions. Upon enrollment, each participant completed a demographic-data form (Appendix D), which served as an informed consent. The PI collected the form prior to, or at, the educational session. The teaching was conducted in four different prescheduled classrooms across the organization, which were equipped with audiovisual equipment to facilitate the lectures on DQ and EiN.

### **Population and Sample**

A convenience sample consisting of RNs providing direct inpatient care was recruited from the MSUs and CCUs. This study recruited from all eligible nurses working day or night shifts, weekdays or weekends. The inclusion criteria were (1) full-time and per-diem RNs with a diploma: an associate degree in nursing (ADNs), or baccalaureate of science degree in nursing (BSNs); (2) at least three months' experience with MediTech or EHRs, and (3) currently using electronic documentation for patient charting. The exclusion criteria were (1) part-time RNs, (2) RNs unable to chart within two weeks post-intervention, and (3) any RNs with DQ or research training.

A total of 165 individuals volunteered to participate in the study; 11 of these were excluded for the following reasons: (1) two participants did not complete a shift assessment within one to two weeks post-intervention, as required; (2) two participants left the organization, (3) two participants did not complete the shift assessment, (4) three participants signed the informed consent but did not attend the required lecture; and (5) two participants did not meet the inclusion criteria. Overall, 154 participants completed the study, and were part of the intervention ( $n = 77$ ) or the control ( $n = 77$ ) groups.

A pilot study with the first 24 participants was performed earlier, and the data analysis informed the final study. Of the 24 pilot participants, 14 were in the intervention group. The pilot participants ultimately were included in the total sample number. No significant changes were made to the study protocol after the pilot study.

The participants for this research study were nurses voluntarily enrolled in the DQ research study, attending the educational intervention, and electronically documenting a patient shift assessment within two weeks post-intervention. They were randomized based on their units' location to receive either a one-hour lecture "Data Quality and the Nursing Profession in the 21<sup>st</sup> Century" or a one-hour lecture "Ethics in the Nursing Profession in the 21<sup>st</sup> Century." The randomization process was a one-stage randomization process using a coin flip. To avoid sample contamination, a unit location-based randomization strategy was used rather than randomizing each participant. The units' randomizations are shown on the randomization framework chart below (see Figure 3. 1).

The selection of the units for participation was based on unit skills similarities, number of nurses per unit, and location (e.g., different floor, different building, etc.). If the participant was unable to complete a patient shift assessment within two weeks post-intervention, s/he was excluded from the study. Also, the PI highlighted to the participants that they were not to discuss the intervention received with participants from other floors and reassured them of confidentiality in the results of the chart audits.

*Figure 3.1.*

#### Unit's Characteristics and Randomization

Department Name	Specialty Area	Randomization
General Surgery	Med-Surg	EiN – Pilot
Surgical Intermediate	Med-Surg	DQ – Pilot
Stroke, "MedSurg", Observation	Med-Surg	EiN
Oncology, Rehab	Med-Surg	DQ
Medical Intermediate, Cardiac Medical	Med-Surg	EiN
CVI, CVII	Med-Surg	DQ
ICU	Critical Care	EiN
IMCU, NICU, CVICU,CCU	Critical Care	DQ

The sample size was based on a power analysis with an assumed medium effect odds ratio = 1.3. With power set at .80, alpha at .05, and use of a two-tailed test, a sample size

of 153 subjects for the final study was needed for the logistic regression (Appendix F). This study recruited all eligible nurses.

### **Protection of Human Subjects**

Permission from the hospital was obtained as an exempt research project in July 2017 and the Institutional Review Board (IRB) at Texas Woman's University approved the research study in August 2017 (see Appendix G1&G2). There was a small, potential risk in this study for loss of confidentiality in email communications, but the risk was determined to be minimal as the participants were assigned a subject code based on the randomization criteria. The PI had access to participant names, randomization, and audit results. To offer participants continued education credits, the hospital education department and the Texas Board of Nursing received the participants' name for their certificates.

The informed consent (IC)/demographic data form contained a subject code that each of the participants received (Appendix D); the subject code was in the master Excel and SPSS databases. In the pilot study, 24 participants were recruited; 14 in the DQ arm, coded A1 through A14, and 10 participants in the EiN arm, coded B1 through B10. Because they were included in the final sample, for this study, the participants' code numbers continued this numbering: (1) the participants receiving DQ lectures were labeled A15, A16, and so forth, and (2) the participants receiving the EiN lectures were labeled B11, B12, and so forth. The only identifiers, present on the demographic informed consent form, were kept under double lock in the PI's office.

The PI entered the de-identified dataset directly into Excel and transcribed it into the SPSS database; both were available to the PI on a password-protected computer. All identifying information will be destroyed within five years after the study is finished. The results of the study will be reported in a peer-reviewed journal with aggregated, de-identified information.

### **Instruments**

The PI developed a tool for collecting and evaluating the accuracy, completeness, timeliness, and objectivity of nurses' data quality (ACTO\_RNs DQ), based on two theoretical models: the product and service performance model for information quality and the conceptual model of information quality measurements frameworks. The tool measured the DQ components as the dependent variables: accuracy, completeness, timeliness, and objectivity. The ACTO components were audited in the MediTech electronic health record. Each of these DQ components was coded according to the ACTO\_RNs DQ grading criteria (Appendix H).

The organization was using fully integrated, interoperable EHRs software: the MediTech platform. The MediTech platform is a key-functions guided system with drop-down menus that have predetermined choices built into the electronic system and free-form writing options with a standardized, structured language. Each drop-down menu offers an optional comments section. Based on MediTech's functions, the ACTO components were audited.

To evaluate accuracy, the nurses were told that after the vital signs were electronically recoded via the Allen Welch monitor and transmitted to the MediTech

electronic record, they were to open the page, verify the accuracy of the BP/vital signs with the patient's condition, and acknowledge the findings with a short statement "BP or vital signs, acknowledged or verified." No credit was given to those who did not verify the BP according to the PI's instructions.

Completeness was operationally determined by whether all 19 shift-assessment fields, categories, and subcategories were filled out. At the beginning of each shift, each RN is required to conduct a shift patient assessment and document all the 19 fields. In MediTech version 5.6.7, the patient shift assessment documentation is comprised of 1,500 queries and fields and based on where the patient was admitted (e.g., CCU, CV-ICU, Neuro-ICU, Med Surg., Oncology, etc.), some of these fields may be grayed out. The 19 fields contained pre-set documented criteria as "within defined parameters (WDP)" and "Yes/No" subcategories options; the subcategories were documented on drop-down and comment menus.

To evaluate completeness, credit was given when the categories and subcategories were completed according to institutional guidelines or policy. Per institutional policy, the RNs were required to complete a shift assessment for each patient by the end of the shift. Based on the study's intervention instructions, for the benefit of the patient, the participants were taught to complete the shift assessment within four hours after the shift report was given. The time stamp for the shift report was the time when the incoming nurse logged in to MediTech. To evaluate the timeliness, we have subtracted the time elapsed in minutes between the "recorded" field and "occurred" field, and credit was given according to the ACTO\_RNs DQ algorithm (see Appendix C).

To evaluate the objectivity, credit was given when the care plan (CP) was initiated or updated, the sections were objectively filled out, and nursing notes were unbiased. The goals/outcomes of the CP were based on the goal, progress, and outcome of the problem(s): (1) deteriorate, (2) improve/resolve, or (3) stabilize/maintain. The participant was also expected to make a comment in the comment section to the patient's outcome, objectively stated with a supporting assessment on how the problem has improved or changed over time throughout the shift.

### **Data Collection and Procedures**

Following the IRB approval, participant recruitment started. The PI met with the nursing leaders to introduce the research study, obtained their agreement, and got the potential participants' email addresses. After nursing leadership agreed to participate in the study, the nurse-recruitment process was started using flyers (Appendix I), emails (Appendix J), and shift-change-unit-meetings to promote voluntary participation. The potential participants received a recruiting email with the study's title, "Data Quality Research Study," and a brief description of the study. The introduction included an explanation of time allocation, group randomization, inclusion and exclusion criteria, risks and benefits, and other aspects of the informed consent. The schedule for the lectures was posted in each of the units, cafeteria, elevators, lockers, and lunch rooms (see Appendix K). If the participant was unable to decide at that time, the option to attend the lectures and sign the IC before the lecture was given as well.

In addition, to enhance participation, a few days prior to the planned intervention, the PI had a face-to-face conversation with the nurses. To further ensure participation in

the study, the PI achieved the following goals: approval from the Texas State Board of Nursing for one hour of continuing education (CE) credit for each of the education components (see Appendix L1 & L2) and refreshments throughout the intervention time.

Upon arrival, the study purpose was again reviewed with the participants; if they agreed to participate in the study, they then filled out a demographic form/IC and signed a continuing education research roster. The lectures were scheduled throughout six weeks as follows: (1) the PI provided the DQ lecture for three weeks, Monday through Friday, two lectures per day to accommodate nurses working the day and night shifts. One lecture took place from 11:30 a.m. to 12:30 p.m. and the second lecture from 5:00 p.m. to 6:00 p. m. (2) The PI then offered the EiN lectures for the next three weeks, Monday through Friday, two lectures per day, following the same schedule as the DQ lecture. To ensure enrollment of 154 participants, the PI added extra intervention times during the weekends. The PI used PowerPoint presentations, encouraged questions, and included descriptions of case studies to hold the participants' attention. At the close of each lecture, the participants were required to fill out a continuing education survey and take the lecture handout (see Appendix E).

Upon arrival at the lecture, the PI reminded the participants to clock out for this event. Then she asked the nurses to sign the CE roster and take the lecture evaluation forms provided. The PI disclosed the topic of the randomized lecture selection to the participants at that point. At the end of the lecture, the nurses were reminded to fill out the evaluation form, hand it to the PI, and to take and fill in his/her name on the CE form before leaving. Lastly, the PI greeted the nurses and asked if they were interested in

knowing about the study results after study completion; the majority of participants wanted to know the results of the study.

Between one week and two weeks post-intervention, the PI conducted a retrospective chart review for all participants enrolled in the study. The chart audits consisted of an evaluation of each participant's shift health assessment from the MediTech electronic system, including the plan of care.

DQ data components were operationalized and graded by the PI abstractor using the ACTO\_RNs data collection form. The de-identified data were collected onto an Excel spreadsheet and then transferred into a Statistical Package for Social Sciences (SPSS v. 25) database. To ensure that there were no collection errors within the discrete patient data, a few days later the PI performed a quality-control review of the transcribed information. All identifiable information was scheduled to be destroyed no later September 2022, and until then will be kept encrypted on the PI's research laptop.

### **Treatment of Data**

SPSS 25 (SPSS) was used to analyze the data. For research question one, cross-tabulation computation by using Chi-square and Cramer's V tests was employed to examine if there was a difference in accuracy, completeness, timeliness, and objectivity in EHR documentation between the participants who received the DQ lecture and the participants who received the EiN lecture. Frequencies and percentages for outcome variables were calculated.

For research question two, data quality was examined for accuracy, completeness, timeliness, and objectivity in relation to years of nursing experience, and use of EHRs

and MediTech. Thus, several logistic regressions were conducted to examine if nursing and use of EHRs and MediTech experiences predict the accuracy, completeness, timelines, and objectivity of electronic documentation.

The PI transcribed all of the demographics from the paper format into an SPSS database. Upon enrollment, the nurses were informed that, within one to two weeks of the lecture. The PI reviewed the charts in a quiet, private room, away from any clinical activity. The information was transcribed into an Excel database that was created during the pilot study; the information was then transcribed by the PI into the SPSS v. 25 database for analysis. For quality assurance, the PI verified that the data was transcribed from Excel to SPSS correctly.

### **Pilot Study**

As mentioned above, a pilot study was conducted in the fall of 2017. The research methodology was executed as planned and the sample was incorporated into the dissertation study. For the larger dissertation study, the same protocol for recruitment, randomization, intervention, instrumentation, and analysis was followed. The pilot study was conducted in two inpatient nursing units: a surgical intermediate ward and a general surgery ward. As a result of the coin flip, the surgical intermediate unit (SIMU) was randomized to receive the DQ lecture, and the general surgery unit (GSU) was randomized to receive the EiN lecture.

### **Population and Sample**

The population for the pilot study was inpatient staff RNs who provide direct patient care. The convenience sample for the pilot study was 24 nurses recruited from the

two selected units. The sample size was based on a power analysis with an assumed medium effect ( $d = .40$ ). According to Cocks and Torgerson (2013), the sample size for a pilot randomized trial for an 80% power, one-sided confidence interval was estimated to have at least 9% of the sample size of the main intended trial; thus, the estimated number was at least 20 participants.

### **Sample Description**

Descriptive and frequency statistics were computed. Most of the participants were female (83.3%), non-Hispanic (83.3%) and 92% hold lower than a BSN degree; the age of the RNs ranged from 21 to 53 years ( $M = 31.5$ ,  $SD = 8.5$ ); experiences with EHRs ranged from zero to 240 months ( $M = 58$ ,  $SD = 61.8$ ), and experiences with MediTech ranged from three months to 240 months ( $M = 40.3$ ;  $SD = 51.0$ ).

### **Statistical Analysis**

The data for the first research question was subjected to a cross-tabulation computation by using Fisher's exact test and Cramer's  $V$  test to examine whether the DQ teaching intervention made a difference in accuracy, completeness, timeliness, and objectivity in EHR documentation. For the second question, we wanted to see if accuracy, completeness, timeliness, and objectivity were related to the level of education and experience in nursing, MediTech and Mann-Whitney  $U$  nonparametric tests were conducted. The relationship between years of nursing experience and the difference in ACTO components in EHR documentation was tested by conducting cross tabulations using Fisher's exact test and Cramer's  $V$  test.

## **Statistical Results**

Hypothesis One was supported by the following findings: in the DQ group, 78.6% of RNs documented accurately; 64.3% of RNs had more complete shift assessment documentation; 92.9% of RNs completed shift assessments within the four-hour timeframe, and 57.1% of RNs completed the shift assessment more objectively.

Hypothesis two was not supported, and no statistically significant findings were found.

## **Compared and Contrasted with Published Literature**

The study's results align with prior evidence indicating that DQ in EHRs is contingent upon nursing documentation and needs improvement (Michel-Verkerke, 2012). Documenting time was not significant between the participants and units, suggesting that this provision of patient care is dependent upon the setting (Kelley, Brandon & Docherty, 2011). Completeness of documentation has positive results, and there is a continuous need to improve documentation (Mahler et al., 2007). In contrast to other studies (Mahler et al., 2007), this study revealed positive preliminary results related to documented clinical plan information. Based on anecdotal evidence, the nurses find the ACTO\_RNs\_DQ algorithm helpful; thus, it is unique compared with other frameworks cited by Blair and Smith (2012).

## **Pilot Strengths and Limitations**

The pilot study had few strengths. The pilot study used the most trustworthy method of group equalization strategies, randomization (Polit & Beck, 2016). The study method allowed accurate and consistent data collection and analysis through the use of a single abstractor. Also, to avoid sample contamination, the study was conducted in two

separate units, separated by distance with little interaction and no interchanging of RN assignments for two weeks after the intervention per an agreement between the PI and nursing leadership. Furthermore, during the development of the ACTO\_RNs\_DQ tool and algorithm, the PI consulted with her dissertation committee and an independent nurse. Lastly, to enhance documentation scoring of the ACTO\_RNs\_DQ algorithm according to EHRs/MediTech institutional guidelines, the PI consulted with a senior expert nurse at the MediTech corporation.

The pilot study had two limitations. One was related to nursing assignments. Due to a nursing shortage, there was a remote possibility of cross-unit communications. The second limitation was related to the scoring of the ACTO\_RNs\_DQ algorithm on the objectivity component. Of 24 subjects, on the plan of care (POC), only nine subjects answered in the evaluation comment section; perhaps the participants found additional commentary on the evaluation to be unnecessary.

## **Conclusion**

DQ in documentation leads to accurate clinical assessment and good care plans (Gogler, Hullin, Monaghan & Searle, 2009). Thus, in this pilot phase, it was found statistical indications that the educational intervention improved EHRs documentation; determined that the ACTO algorithm can be used to test the intervention; and based on empirical evidence, found that the participants were receptive to applying the ACTO algorithm during shift assessment documentation. Limitations identified from the pilot study were addressed as follows: (1) the PI asked the nursing leadership to not assign the

nurses on other floors/locations throughout the study, and (2) during intervention time, the PI emphasized to the participants to fill out all the PC sections.

## CHAPTER IV

### ANALYSIS OF DATA

The use of EHRs worldwide has risen significantly in the last decade (Reis et al., 2013). In the United States, the Health Information Technology or HITECH Act of 2009 made clear the need for digitizing the healthcare delivery system (Washington, DeSalvo, Mostashari, & Blumenthal, 2017). However, the quality of documentation is still hampered due to the complexity and uncertainty of the healthcare system today (Lanham et al., 2014).

The quality of data, such as with vital signs, is paramount in guiding a patient's bedside care (Skyttberg et al., 2016). Based on Weiskopf and Weng's (2013) remake, five dimensions of DQ were identified in the literature: completeness, correctness, concordance, plausibility, and currency. However, this study's model identified four dimensions important to bedside nurse: accuracy, completeness, timeliness, and objectivity. Thus, these four dimensions were identified and assessed in nursing documentation within the EHR/MediTech platform, and a description of the sample and the study results are presented in this chapter.

This quantitative study aimed (1) to evaluate the effectiveness of an educational intervention in improving the DQ of registered nurses' documentation in EHRs and (2) to evaluate if there is a relationship between years of nursing experience and experience with EHRs and data quality in terms of accuracy, completeness, timeliness, and objectivity.

Summary and discussion of the findings were focused on answering two research questions: (1) Are there any differences in DQ accuracy, completeness, timeliness, and objectivity between inpatient staff RNs who received a one-hour, in-class education session on the importance of DQ in EHRs and RNs who received a one-hour, in-class education session regarding ethics in nursing (EiN)? And (2) What are the relationships between years of nursing experience, experience with EHRs, and data quality regarding accuracy, completeness, timeliness, and objectivity?

### **Description of the Sample**

A total of 165 RNs from 16 medical and critical care inpatient units were enrolled, and 154 participants participated in the study. Of the 16 units, two units were part of the pilot study, supplying 24 RNs, out of the 154, who participated in the study. The study, randomized based on the unit's location, was comprised of bedside nurses who performed a similar set of skills in various medical and surgical units located throughout the institution.

Of the 84 participants recruited in the DQ group only 77 participants participated in the study. Seven participants were withdrawn as follows: one participant completed the shift assessment after two weeks instead of within two weeks; one of them left the organization, two participants did not complete a shift assessment as required for the study, and three participants signed the informed consent but did not attend the required lecture. Of the 81 participants recruited in the EiN group, only 77 participants participated in the study; two were screen failures; one left the organization; and the other

participant did not complete a shift assessment within one to two weeks post-intervention.

Frequencies and percentages for the categorical demographic variables are displayed in Table 4. 1. The sample was comprised of 77 participants in the DQ group and 77 participants in the EiN group. Most of the participants were female (83.1%), between the ages of 23 and 37 years (66.7%), non-Hispanic (63.8%), Caucasian (52.3%), had an associate degree in nursing (ADN) (51.9%), with at least three months, but not more than two years, of nursing experience (49.9%). Most of the participants had not used any EHR systems other than MediTech (50.7%), and most of the participants had between three and 24 months' experience with MediTech (61.7%).

Table 4.1.

*Frequencies and Percentage for Categorical Variables*

Categorical variable	<i>n</i>	%
Group		
DQ	77	50.0
EiN	77	50.0
Gender		
Female	128	83.1
Male	26	16.9
Age (range of years)		
Gen Z (18 to 22)	4	2.6
Gen Y (23 -37)	102	66.7
Gen X (38-52)	41	26.8
Baby Boomers (53-71)	6	3.9
Ethnicity		
Hispanic	50	36.2
Non-Hispanic	88	63.8
Missing	16	--

Categorical variable	<i>n</i>	%
<b>Race</b>		
African American	24	15.9
Asian	24	15.6
Caucasian	79	52.3
Native American	1	0.7
Other	23	15.2
<b>Level of education</b>		
Diploma	4	2.6
ADN	80	51.9
BSN	67	43.5
Masters	3	1.9
<b>RN Experience</b>		
3 months - 2 years	76	49.4
2 -10 years	55	35.7
10 - 25 years	20	13.0
More than 25 years	3	1.9
<b>Experience with EHRs</b>		
Never used other EHRs (other than MediTech)	77	50.7
3 months - 2 years	23	15.1
2 - 10 years	36	23.7
10 - 25 years	16	10.5
<b>Experience with MediTech</b>		
3 months - 2 years	95	61.7
2 - 10 years	47	30.5
10 - 25 years	12	7.8

*Note: Frequencies not summing to N = 154 reflects missing data*

### **Findings**

Statistical Package for Social Sciences 25 (SPSS) was used to analyze the data. For research question 1, cross-tabulation computation by using chi-square and Cramer's V tests was employed to examine whether the DQ teaching intervention made a difference in accuracy, completeness, timeliness, and objectivity in EHR documentation.

Frequencies and percentages for outcome variables were calculated and displayed in Table 4. 2. A total of 154 participants completed post-intervention shift-assessment entries. Of these, 30.5 % accurately documented patient BPs; 49.9% completed all the shift assessment’s fields. Most of the shift assessments were completed within four hours of shift report (77.9%), and 28.6% of documentation was identified as objective.

Table 4.2.

*Frequencies and Percentage for Outcomes Variables*

Outcome variable	<i>n</i>	%
Accuracy		
Inaccurate	107	69.5
Accurate	47	30.5
Completeness		
Incomplete	78	50.6
Complete	76	49.4
Timeliness		
By the end of the shift	34	22.1
Within 4 hrs	120	77.9
Objectivity		
Not-objective	110	71.4
Objective	44	28.6

*Note: Frequencies not summing to N = 154 reflects missing data*

As shown in Table 4.3, the relations were significant as follows: Accuracy:  $X^2 = 62.01, p < .001$ , Cramer’s  $V=.635$ . A greater proportion of the participants who were in the DQ group (59.7%) documented BP accurately than in the EiN group (1.3%).

Completeness:  $X^2 = 33.69, p < .001$ , Cramer’s  $V = .468$ . A greater proportion of the participants in the DQ group (72.7%) documented the shift assessment completely than in

the EiN group (26.0%). Timeliness:  $X^2 = 12.23$ ,  $p < .001$ , Cramer's  $V = .282$ . A greater proportion of the participants in the DQ group (89.6%) documented within four hours after report was given than in the EiN group (66.2%). Objectivity:  $X^2 = 45.95$ ,  $p < .001$ , Cramer's  $V = .546$ . A greater proportion of the participants in the DQ group (53.2%) documented the plan of care objectively than in the EiN group (3.9%).

Table 4.3.

*Frequencies and Percentages ACTO by Groups*

	DQ		EiN		$X^2$	$p$	Cramer's $V$
	$n$	%	$N$	%			
<b>Accuracy</b>							
Inaccurate	31	40.3 <sup>a</sup>	76	98.7 <sup>b</sup>	62.01	<.001	.635
Accurate	46	59.7 <sup>a</sup>	1	1.3 <sup>b</sup>			
<b>Completeness</b>							
Incomplete	21	27.3 <sup>a</sup>	57	74.0 <sup>b</sup>	33.69	<.001	.468
Complete	56	72.7 <sup>a</sup>	20	26.0 <sup>b</sup>			
<b>Timeliness</b>							
By the end of the shift	8	10.4 <sup>a</sup>	26	33.8 <sup>b</sup>	12.23	<.001	.282
Within four hours	69	89.6 <sup>a</sup>	51	66.2 <sup>b</sup>			
<b>Objectivity</b>							
Not objective	36	46.8 <sup>a</sup>	74	96.1 <sup>b</sup>	45.95	<.001	.546
Objective	41	53.2 <sup>a</sup>	3	3.9 <sup>b</sup>			

*Note: For each row category, pairs of column proportions with different superscripts differed significantly*

For research question two, several logistic regressions were conducted to examine if nursing and use of EHRs and MediTech experiences predicted the accuracy, completeness, timeliness, and objectivity of electronic documentation (Table 4.4).

Table 4. 4.

*Summary of Logistic Regression Predicted for Accuracy, Completeness, Timeliness and Objectivity*

	$\beta$	Odds Ratio	95% CI		<i>p</i>
			Lower	Upper	
<b>Accuracy</b>					
Years of experience as a RN	.254	1.290	.717	2.319	.395
Experience with EHRs	-.024	.976	.909	1.049	.512
Experience with MediTech	-.263	.768	.372	1.586	.476
<b>Completeness</b>					
Years of experience as a RN	-.368	.692	.389	1.230	.210
Experience with EHRs	-.001	.999	.971	1.027	.918
Experience with MediTech	.234	1.264	.635	2.517	.505
<b>Timeliness</b>					
Years of experience as a RN	.234	1.264	.612	2.608	.527
Experience with EHRs	.051	1.052	.833	1.327	.670
Experience with MediTech	.176	1.192	.492	2.865	.695
<b>Objectivity</b>					
Years of experience as a RN	.404	1.498	.825	2.723	.185
Experience with EHRs	-.038	.963	.830	1.117	.617
Experience with MediTech	-.041	.959	.468	1.967	.910

The model for predicting accuracy was:  $X^2 = 1.661, p = .646$ , Nagelkerke  $R^2 = .015$ ; the model for predicting completeness was:  $X^2 = 1.704, p = .636$ , Nagelkerke  $R^2 = .015$ ; the models for predicting timeliness was  $X^2 = 3.017, p=.389$ , Nagelkerke  $R^2 = .030$ , and the models for predicting objectivity was  $X^2 = 3.755, p = .289$ , Nagelkerke  $R^2 = .035$ . Overall, none of the predictors were significant predictors of DQ in electronic documentation in terms of accuracy, completeness, timeliness, and objectivity of data quality components.

### **Summary of the Findings**

Overall, data analysis found positive evidence addressing the first research question but found no correlation related to the second research question. After the intervention, participants ( $N=154$ ) completed shift assessment entries using ACTO algorithm documentation; the DQ group's documentation was more accurate (59.7 %), more complete (72.7 %), timelier (89.6 %) and more objective (53.2 %). Unlike the study by Ahn, Choi, and Kim (2016), the current study found years of nursing experience were not statistically significant when associated with the timeliness of nursing record documentation. None of the predictors, the years of experience in nursing, experience with EHRs, or experience with MediTech, led to a significant difference in relation to quality of electronic documentation in terms of accuracy, completeness, timeliness, and objectivity.

## CHAPTER V

### SUMMARY OF THE STUDY

Leveraging EHRs to maintain high-quality healthcare could provide more effective service, stronger decision making, and better care coordination (Greiver et al., 2015). EHRs have brought tremendous benefits, especially during the transition from paper documentation to an electronic version, but those benefits are highly dependent upon the electronic system producing trustworthy, correct, and real-time data. Despite the benefits of EHRs, robust evidence regarding the negative effects of poor data quality exists, and there is a paucity of evidence regarding how to achieve good data quality in EHRs (Muthee et al., 2018). The hypotheses of this study were (1) an educational intervention would improve the DQ of registered nurses' documentation in EHRs, and (2) there might be a positive correlation between nursing experience, experience with EHRs, and data quality in terms of ACTO.

Therefore, a randomized intervention-design study was performed to better understand DQ improvement among inpatients medical and critical care nurses at the patient's bedside. This chapter provides a summary and discussion of the findings, the implications for nursing practice, and recommendations for future studies.

#### **Summary**

This study investigated the change in quality of nursing documentation based on the use of a newly developed ACTO algorithm. Currently, information captured daily in

electronic documentation still displays poor quality (Thurston, Wayne, Feinglass, & Sharma, 2014). It is inaccurate if entered in real time, is missing data elements (Ali et al., 2018), and does not objectively portray the patient's status (Peres et al., 2012). This study, conducted in a suburban inpatient hospital, was designed to assess the quality of data entered in EHRs by medical floor and critical care RNs. The units were randomized, and the participants were attending one hour of a continuing education class addressing DQ or EiN. Within two weeks after the lectures, a randomly selected shift assessment was audited for each of the participants. Four DQ data elements were collected: accuracy (A) in terms of recorded and verified blood pressure measurements, completeness (C) in terms of all shift assessment data elements completed, timeliness (T) in terms of the timing of the shift-assessment documentation, and objectivity (O) in terms of completion of an unbiased patient care plan and/or nursing notes.

The ACTO algorithm was created from DQ research based in industries outside of healthcare (Knight & Burn, 2005; Lee et al., 2002; Stvilia et al., 2007). DQ elements that could translate to a bedside nurse's set of skills were abstracted from the non-healthcare research. Therefore, a feasibility study was conducted to determine the details of study implementation, including treatment and attention control interventions, and how DQ elements of interest could be extrapolated from EHRs, namely the MediTech platform.

The data were examined using cross tabulation (Aim 1) and multinomial regressions (Aim 2).

## Discussion of the Findings

### Aim One

Prior studies examined EHR DQ in general, examining various factors such as accuracy (Blair & Smith, 2012; Ward, Self, & Froehle, 2015), completeness (Kelley et al., 2015; Kent & Morrow, 2014; Wright, 2012), timeliness (Ahn, Choi, & Kim, 2016; Sockolow, Bowles, Adelsberger, Chittams, & Liao, 2014), or objectivity (Peres, 2012). However, to our knowledge, there has been no prior research evaluating nurse-driven DQ elements in electronic documentation.

The current study showed an improvement in nurses' charting after the DQ intervention was performed. The nurses from the DQ group, having been taught the ACTO algorithm, improved by 53.2–89.6% compared to the EiN group in all four ACTO categories. The largest improvements by the DQ group were noted in the timeliness element, by 89.6%, and the completeness element, by 72.7%, which indicated that the DQ in the EHRs system could be enhanced when the nurse has a clearer understanding of the implications of these data elements at the patient's bedside.

**Accuracy.** The participants in the DQ group demonstrated better accuracy on BP documentation, compared to the EIN group, because they understood the reasons behind the entries. The participants were taught that integration of their DQ knowledge into electronic documentation brought significant advantages. However, without any reliance on clinical knowledge and experience to rely on, using technology carries risk and affects person-centered practices (Skyttberg et al., 2016).

In this study, poor accuracy reflected a limitation in knowledge that improved after one educational event. Compared with previous studies (Forberg et al., 2012; Inan & Dinç, 2013; Puttkammer et al., 2016), poor DQ was due to inaccurate documentation related to multiple reasons (e.g., lack of a standardized language, duplicate notations, omitted information, insufficient training, lack of awareness regarding EHRs' functionalities, widely varied terminology used by healthcare providers, or failure to recall in detail the task that was performed at the patient bedside, missing vital signs, etc.).

**Completeness.** The nurses in the DQ group improved in the completion of data elements because they were taught the implications of The Joint Commission's requirements for an institution's core quality performance (The Joint Commission, 2017). Unlike previous studies, (Byrd et al., 2013; Forberg et al., 2012; Inan & Dinç, 2013; Puttkammer et al., 2016; Spuhl et al., 2014; Wang et al., 2013), in which poor DQ was simply correlated to the observation of incomplete documentation, in this study completeness significantly improved after the educational event.

**Timeliness.** Regardless of the nurse-patient ratio, the participants in the DQ group significantly improved on timely shift assessment, compared to the EiN group, because they learned the urgency of medical decisions based on timely information. After the DQ intervention, participants showed improved awareness of timely documentation of BP variation as indicated by medical orders received immediately after the participant's entries. However, those instances in which the DQ group was not timely were due to the

DQ participants receiving additional patients, making it difficult for them to complete documentation within four hours, as instructed.

Compared with a previous retrospective study (Wang et al., 2013), in which completeness and timeliness of DQ in EHRs did not improve, a cohort study (Byrd et al., 2013) using a clinical-assessment tracking system showed improvement in completeness and timeliness, indicating at least two different interventions, tracking system oversight and education, can be considered when improved DQ is desired. However, in consideration of cost, a one-time educational event has an advantage over the expense of creating, maintaining, and monitoring an oversight system.

**Objectivity.** The nurses in the DQ group completed the patient's care plan and nursing notes objectively throughout the work shift. However, compared with a previous study, in which the narrative notes were ubiquitous (Spuhl et al., 2014), most of the nursing notes and care plan were clear and objectively described in this study after the educational event.

## **Aim Two**

There are conflicting findings regarding a possible association between level of experience among healthcare providers and DQ. Some previous studies did find a correlation (Bramble et al., 2013; Dillon et al., 2017; Lee et al., 2005; Puttkammer et al., 2016). However, as in other studies (Inan & Dinç, 2013; Sanders et al., 2016), the current study found no association between DQ and length of experience of healthcare providers; in this case, nursing staff. In the current study, as in Inan et al.'s (2013) and Sanders et al.'s (2016) research, ongoing educational programs were identified as increasing

awareness among providers and improving EHRs' accuracy. Overall, none of the demographic predictors (i.e., years of experience in nursing, experience with EHRs, or experience with MediTech) made significant differences in the documentation of the four DQ elements of interest: accuracy, completeness, timeliness, and completeness.

### **Theoretical Framework, Study Findings, and Relations**

Two parent theoretical frameworks were used as the foundation for the current study's model, the ACTO\_RNs\_DQ model and the ACTO algorithm. The ACTO\_RNs\_DQ framework, developed through a rigorous and pragmatic concept synthesis, was the foundation for the ACTO algorithm. The participants who received the DQ lecture were trained to use the ACTO algorithm as the framework for their electronic documentation.

The foundational theoretical models by Lee et al. (2002) and Stvilia et al. (2007) were congruent with the newly developed ACTO\_RNs\_DQ theoretical framework and with overall nursing practice. The Lee et al. (2002) model focused on product or service delivery within an organization. The DQ lecture, delivered to the study participants in the DQ group, focused on the importance and implications of delivering quality documentation. Thus, as they focused on product or service delivery, the participants became self-aware, ensuring that all 19 fields and subfields of the shift assessment were filled out with all of the required data elements. Also, they attempted to complete the shift assessment promptly, although they encountered many unexpected obstacles throughout the shift.

The Stvilia et al. (2007) theoretical model contained three attributes: intrinsic, rational, and reputational attributes. Based on the intrinsic attributes, the participants were guided to sustain the quality of their documentation within their practice and to use the ACTO algorithm. Based on rational attributes, participants were made aware of the importance of DQ with the goal of completing the shift assessment without missing data elements. Also, when the BP was recorded in MediTech, the participants ensured that the information was transferred from the Allen Welch vital signs recording device to MediTech electronic records and verified that the BP was the true reflection of the patient's state of health by looking at the patient and position of the BP cuff.

Based on reputational attributes, the participants increased awareness of the role that the DQ plays in the EHRs, within institutional settings, and in relation to the Centers for Medicare and Medicaid's (CMS) and Joint Commission's (JC) current core measures. Finally, based on the intrinsic and reputational attributes of the Stvilia et al. (2007) theoretical model, the participants became more aware of JC and CMS regulations and they updated/initiated the plan of care and completed unbiased nursing notes, maintaining an objective narrative.

Peres et al. (2012) suggested seeking models that integrate technology with human dimensions. As human dimensions, self-reflection on the DQ elements and an understanding of the ACTO algorithm were among the participants' goals after the DQ lecture. Despite the participants' experiences and the complexity of the MCUs, the ACTO algorithm was used as an active tool and part of the DQ participants' daily documentation process. Lastly, most of the participants implemented this algorithm at

the bedside and based on the participants' statements (see Table 5.1); they appeared to find it useful during the documentation process.

Table 5. 1.

*Participants' Testimonies*

Study	Nurse Statements Regarding ACTO Algorithm
Pilot study	<ol style="list-style-type: none"> <li>1. "Helped me finish my documentation in a timely manner &amp; make sure to document their vitals have been evaluated."</li> <li>2. "Helped with time management, organization, and improved patient outcomes."</li> <li>3. "It makes it more organized and follows our shift assessment. Also, it helped me to with communicating with the patients and doctors."</li> <li>4. "I was only aware of vitals when the techs made mention they were out of parameters. However, verifying the vitals and making a note makes me more aware of the vitals and able to provide better care for my patients."</li> </ol>
Dissertation study	<ol style="list-style-type: none"> <li>1. "Helped me with the plan of care because I put action to my interventions."</li> <li>2. "Yes, I've truly benefited from ACTO methods. My priority was to assess and notify immediately; however, I lacked the necessary documentation required."</li> <li>3. "With the introduction of the ACTO algorithm, I feel more confident with charting. It provided me with a clear path to follow for accuracy and completion for charting."</li> <li>4. "I liked writing the action plan for my plan of care &amp; monitored patient bp throughout the shift".</li> </ol>

## **Study Limitations**

Through this study, new information regarding DQ in EHRs and the novel use of the ACTO algorithm were evaluated; however, limitations were observed. First, though the intervention lectures were prescheduled in conference rooms, the lectures were not mandatory, and the participants were required to clock out from their units. Therefore, the lectures were subject to interruptions. The participants were required to answer their assigned portable phones if the unit called, thus distracting from the lecture. Hence, changing the lectures to a paid, mandatory educational event would increase future feasibility of the study.

Second, unexpected staffing shortages in MCUs resulted in increased workloads for nurses. Thus, as in one of the earlier studies (Hafsteinsdóttir et al., 2013), organizational changes occurred during the study period. Therefore, caution is indicated when generalizing the results to other organizational settings and nurses.

Lastly, the study utilized a DQ intervention that has not been specifically utilized in this population before; the PI created an educational intervention for this study based on expert content advice and literature review. To indicate the effectiveness of this intervention, an attention control group was utilized, and findings indicated change resulting from the intervention.

## **Conclusions and Implications**

Many in the nursing profession are a part of the generation that did not grow up with advanced technology (Peres et al., 2012). Knowledge and skill in computer use can be considered relatively new tasks, given the rapid changes in computer technology since

the development of EHRs in 1992 (Evans, 2016). However, the nursing profession is experiencing a paradigm shift, requiring nursing knowledge and information to be transferred from the human body to a technology-intensive model, which is attempting to computerize nursing care (Monteiro, 2016). This lack of expected demographic predictors limits the ability to identify which subsections of the nursing population may respond more readily to DQ training.

Logically, one would expect that years of experience in nursing should make a significant difference in the quality of electronic documentation because one expects that the more experience a nurse has, the better the documentation will be. The current study findings indicated that the years of experience in nursing alone did not support a statistically significant change in DQ in terms of the four quality data elements. Other studies did find a statistically significant correlation between years of nursing experience and the timeliness of documentation in nursing records (Ahn, Choi, & Kim, 2016). However, in this study, almost half of participants (49.4%) had no more than two years' experience in nursing; thus, they did not have enough experience to affect the quality of their electronic documentation significantly.

The following conclusions were drawn from the study:

1. This study indicated that DQ in EHRs improved when the ACTO algorithm was used by bedside nurses. After the DQ lecture, the nursing staff became more aware of DQ elements and the quality and timeliness of documentation, and they changed their behaviors based on this knowledge.

2. Experience alone, whether in relation to nursing, with EHRs, or with MediTech, did not affect the quality of documentation. Thus, this experiential knowledge alone is not enough to produce a good DQ; an intervention is required to produce satisfactory DQ in electronic documentation.
3. The study indicates that the ACTO algorithm was easy to use as a mental algorithm.
4. To our knowledge, until this study, no previous randomized control trial (RCT) using an educational intervention and focused on nurse-driven DQ has improved DQ in EHRs.

The research study had the following implications for improving the quality of documentation in EHRs:

1. According to the 2012 American Medical Informatics Association Health Policy Meeting, a national understanding of health data use was recommended (Hripcsak, 2012); thus, nurses need to better understand the value of data, and the DQ lecture should become a required part of performance development curricula.
2. Because the nurses were distracted during the intervention/lectures, in future lectures, any electronic devices should be turned off and interruptions minimalized.
3. A booster effect might be achieved if a reminder on the use of the ACTO algorithm is instituted.

### **Recommendations for Further Study**

Future studies are warranted to investigate DQ improvement in nursing practice; therefore, the following recommendations are indicated:

1. Replicate this study in another healthcare institution that uses an EHR other than MediTech to support ACTO generalizability.
2. Conduct a study in various clinical environments and patient populations. The current study analyzed DQ only in adult patients in MICU wards.
3. Conduct a qualitative study on nurses' perceptions regarding the ACTO algorithm to reveal which information's influence behavioral changes.

Overall, if nursing professionals are to take effective advantage of information technology, nurses must be empowered in the use of technology. In the future, the EHRs will serve as a data repository based on international standards (Evans, 2016); hence, nursing professionals need to clearly understand the value of DQ in EHRs and be prepared for new channels of electronic documentation, such as genomic data. With appropriate education, nurses can develop more appreciation of the quality of data in relation to patients' safety.

While technology will create yet unknown data capture opportunities, one must continue to pay attention to the core issues, including high-quality data in EHRs and achieving better health outcomes for individuals and populations (Cusack et al., 2013). Preparing nurses today for an expanded tomorrow means the nursing profession will be ready to manage a variety of electronic data elements and be constantly vigilant regarding

documentation and monitoring DQ processes. Data is a powerful tool for healthcare, but only good-quality data will save lives.

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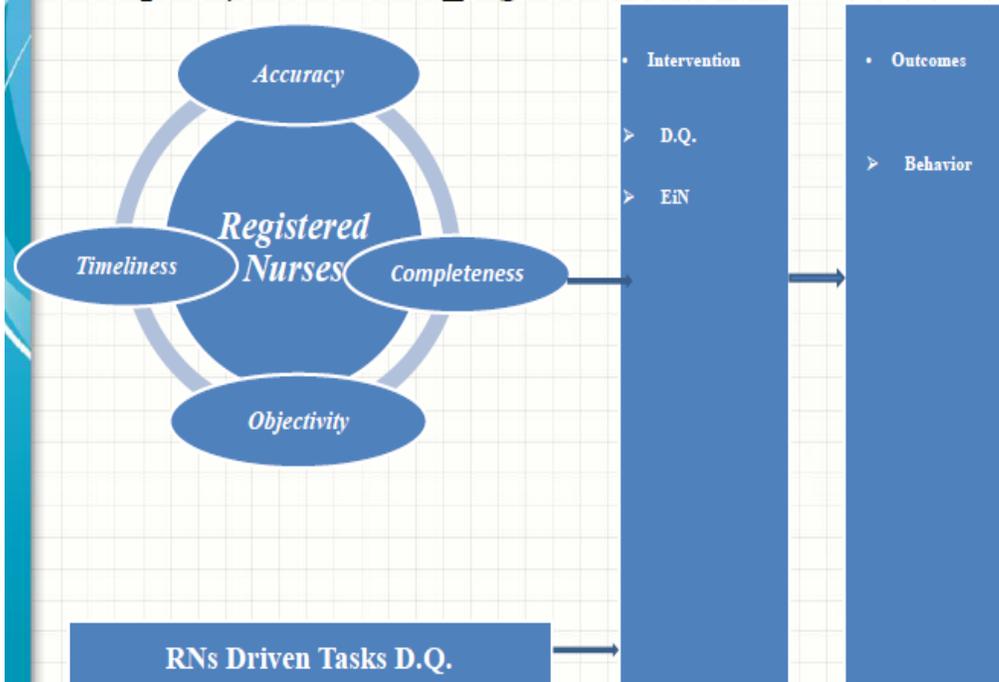
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## APPENDIX A1

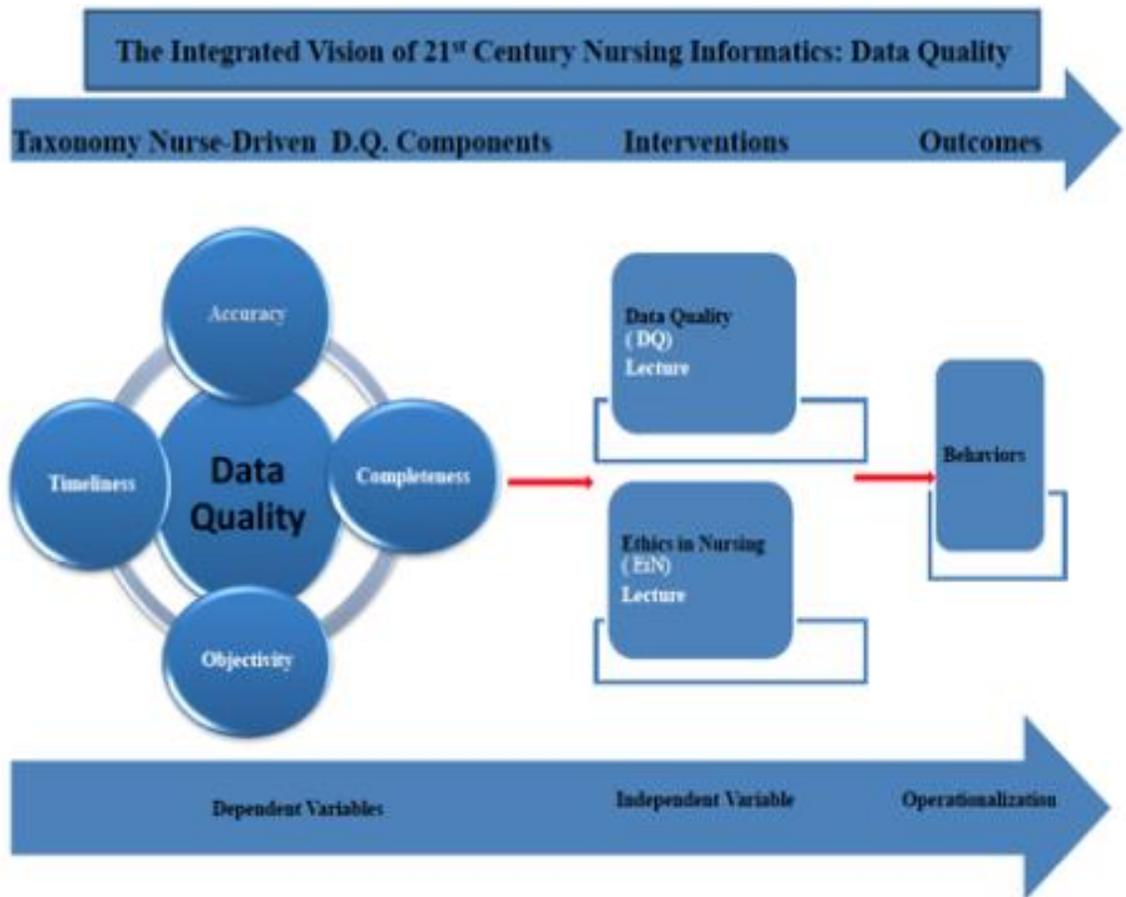
### The ACTO\_RNs\_DQ Framework

*Framework for Evaluating Accuracy, Completeness, Timeliness, and Objectivity for Registered Nurses' driven data quality (ACTORNs\_DQ)*



## APPENDIX A2

### Theory & Variables Relation



## APPENDIX B

### Operationalization of the ACTO\_RNs\_DQ Algorithm

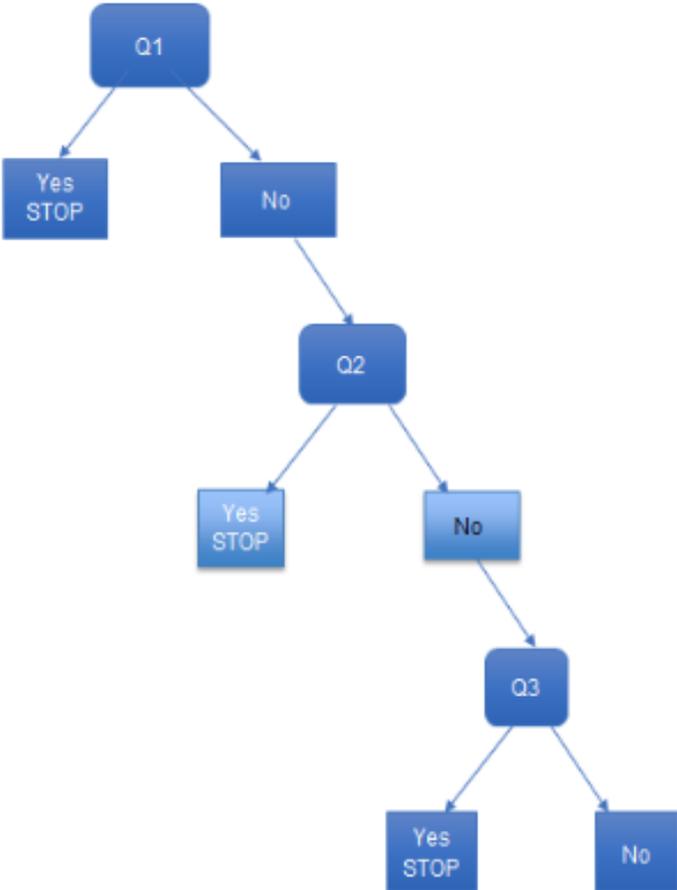
DQ Elements	a. Addressed (0=no, 1=yes)	b. Consistent to the protocol (0=no, 1=yes)	b. Differs & explanation given (0=no, 1=yes)	d. Comments	Final Score
Accuracy	Addressed – if the BP is recorded, viewed (click) and <b>verified (nursing notes)</b>	Consistent- if the BP is recorded with fluctuations and requires interventions according to dep protocol	Differs and explanation - if the BP is recorded with fluctuations and explanation given		
Completeness	Addressed – all 19 categories and sub categories entered correctly	Consistent – all subcategory are entered according to hospital guidelines	Differs and explanation is given		
Timeliness	Addressed – if the shift assessment is occurred and recorded in less than 4 hours	Consistent- if the shift assessment is entered according to the unit/hospital policy/protocol by the end of the shift	Differs and explanation is given		
Objectivity	Addressed – the patient's state of health <b>care plan</b> is addressed, corrected, and <b>evaluated/consistent with the unit/hospital policy/guidelines: care plan is initiated and/or updated</b>	N/A	Differs and explanation is given - the patient's state of health was not corrected but an explanation was given throughout the shift	<b>Add info in nursing notes or/and focus assessment are a plus</b>	

2

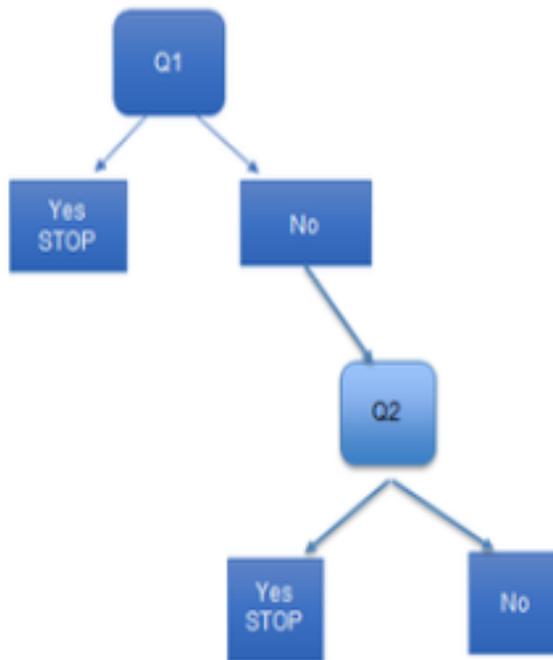
## APPENDIX C

### ACTO\_RNs\_ DQ Algorithm

Accuracy, Completeness, Timeliness Algorithm



Objectivity Algorithm



APPENDIX D  
Demographic Form

<b>Demographics. I am going to start by asking you some general questions about yourself.</b>		
<b>Item</b>	<b>Question</b>	<b>Subject Code # _____</b>
	Race (circle one)	
D1	African American Asian Caucasian Hawaiian/Pac. Islander Native American Other (fill-in) _____	
	Ethnicity (circle one)	
D2	Hispanic Non-Hispanic	
	Age	
D3	What is your age in years? _____	
	Gender (circle one)	
D4	Female Male Transgender	
	Years of Experience as an RN	
D5	How many years have you worked as an RN? _____	
	Level of education (circle one)	
D6	What is your nursing highest educational level? Diploma ADN BSN Master's Doctorate	

D7	Do you have a non-nursing education?	No	Yes
Years of Experience with EHRs & MediTech			
D8	How many years using EHRs? _____		
D9	How long have you used MediTech? _____ months or _____ years		

## APPENDIX E

Lecture Handout DQ & EiN

## **Implement ACTO\_RNs Algorithm**

### **A - accuracy**

- For accurate readings: Check the patient vital signs q x 4 and make a note in nursing notes: Blood pressure/ vital signs acknowledged and verified”

### **C - completeness**

- Complete the head to toes shift assessment

### **T - timeliness**

- Time sensitivity to documentation: within four hours of shift beginning

### **O - objectivity**

- Initiate plan of care and objectively describe the patient condition( e.g. pain level, respiratory condition, cardiac status, etc.)
- Nursing notes: intervene & document objectively

## **The Belmont Report Fundamental Principals-1979**

### **▪ Respect for persons**

- the dignity and autonomy of individuals

### **▪ Beneficence**

- requires the protection of individuals by maximizing anticipated benefits and minimizing possible harms

### **▪ Justice**

- requires that we treat subjects fairly

## APPENDIX F

### Sample Size Calculation

Test family		Statistical test	
z tests		Logistic regression	
Type of power analysis			
A priori: Compute required sample size - given $\alpha$ , power, and effect size			
Input Parameters		Output Parameters	
Determine =>		Critical z	1.9599640
Tail(s)	Two	Total sample size	153
Odds ratio	1.3	Actual power	0.8008918
Pr(Y=1   X=1) H0	0.2		
$\alpha$ err prob	0.05		
Power (1 - $\beta$ err prob)	.8		
R <sup>2</sup> other X	0		
X distribution	Manual		
X Var( $\beta$  H0)	1		
X Var( $\beta$  H1)	1.5		

APPENDIX G1

TWU IRB Approval Letter



Institutional Review Board  
Office of Research  
6700 Fannin, Houston, TX 77030  
713-794-2480  
irb-houston@twu.edu  
<http://www.twu.edu/irb.html>

DATE: August 18, 2017  
TO: Ms. Elena Dragan  
Nursing - Houston  
FROM: Institutional Review Board (IRB) - Houston

Re: *Exemption for Evaluating an intervention to improve Registered Nurses' Adherence to the data quality (DQ) components of Accuracy, Completeness, Timeliness, and Objectivity (ACTO) in electronic health records: A two groups RCT (Protocol #: 19698)*

The above referenced study has been reviewed by the TWU IRB (operating under FWA00000178) and was determined to be exempt from further review.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. Because a signed consent form is not required for exempt studies, the filing of signatures of participants with the TWU IRB is not necessary.

Although your protocol has been exempted from further IRB review and your protocol file has been closed, any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Ainslie Nibert, Nursing - Houston  
Dr. Ann Malecha, Nursing - Houston  
Graduate School

APPENDIX G2

Permission Letter Study Exempt

**Clear Lake Regional**  
MEDICAL CENTER

*An HCA Affiliated Hospital*

July 14, 2017

Re: Elena Dragan : "Evaluating an intervention to improve Registered Nurses' Adherence to the data quality (DQ) components of Accuracy, Completeness, Timeliness, and Objectivity (ACTO) in electronic health records: A two group RCT"

To Whom It May Concern:

This letter is to inform you Elena Dragan has permission to conduct her study (titled above) at Clear Lake Regional Medical Center. As discussed with Ms. Dragan, any and all documented information must be free of protected health information.

Based on a HCA Corporate review, the aforementioned study falls under an exemption and does not require IRB approval. Should IRB approval be a requirement through her educational program, she should apply for IRB approval via Texas Woman's University or the school's IRB Coordinator.

Yours Truly,



Cynthia Gresch, JD, RN, BSN, BA, CPHRM, CPPS  
Patient Safety Officer  
Patient Safety and Risk Management Director  
Clear Lake Regional Medical Center  
450 Medical Center Blvd, Suite 307  
Webster, TX 77598

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APPENDIX H

ACTO\_RNs DQ Grading Criteria

DQ Elements	Grading Criteria		
<b>Accuracy</b>	<b>Accurate</b>	<b>Inaccurate</b>	
	1	0+0+0	
	0+0+1	0+1	
<b>Completeness</b>	<b>Complete</b>	<b>Incomplete</b>	
	1	0+0+0	
	0+0+1	0+1 +0	
	N/A	0+1+0	
<b>Timeliness</b>	<b>On time based on EBP</b>	<b>On time based on the institution policy</b>	<b>Not on time</b>
	1	0+1	0+0+0
	0+0+1		
<b>Objectivity</b>	<b>Objective</b>	Inconsistent throughout the shift or No action or care plan of care implemented	
	1	0	
		0+0; 0+1	

APPENDIX I  
Flyer Recruitment

# Clear Lake Regional MEDICAL CENTER

An HCA Affiliated Hospital

## Research Study

Presented by: Elena Dragan, PhD ©, MSN, RN

Registration Method: Lecture attendance

Date: March-May, 2018

Time:

11:30 am- 12:30pm & 5 pm-6 pm

Location: CLRMC

Number of contact hours awarded: 1.0 CE



## An Educational Intervention to Improve Registered Nurses' Data Quality in Electronic Health Records

**Notification:** An educator and PhD candidate on our campus, Elena Dragan, is conducting a study and MedSurg & CCUs inpatient nurses are invited to participate.

**Start Date:** March 1, 2018. Daily classes from 11:30 am-12:30 pm & 5:00 pm-6:00 pm

This study is expected to contribute to increased awareness of our daily documentation and to a better understanding of the components of data quality.

### Benefits:

- One hour continued education (CE) & lunch provided
- Entry into a drawing for \$200

### What you will do:

- Attend 60 minute class and provide consent to be part of the study

### Dates/Location:

- See further communication via email & look for Data Quality Research Study (DQRS) email
- CLRMC Conference Center – see the email notes (e.g. Searcy, Large Conference Room, AD1026, AD1027, HT 2nd floor.)

**If you are interested please contact Elena Dragan @713-212-9946 and/or arrived at the lecture conference room**

APPENDIX J

Recruitment Email

Email Subject Line: Data Quality Research Study (DQRS)

To: Registered Nurses at Clear Lake Regional Medical Center (CLRMC)

I am a Ph.D. student in the College of Nursing at Texas Woman's University and one of the clinical educators at CLRMC. I am researching the quality of the data documented in our electronic health records (EHRs) for my dissertation study. I am writing to ask if you would be willing to participate in my dissertation research.

I am conducting a study titled, *evaluating an intervention to improve registered nurses' adherence to the data quality (DQ) components of accuracy, completeness, timeliness, and objectivity (ACTO) in electronic health records*. The study has been approved by CLRMC and by the Texas Woman's University Institutional Review Board (IRB).

The purpose of this study is to gain an understanding of data quality related to our daily practice. This study is expected to contribute to increased awareness of our daily documentation and a better understanding of the components of data quality. The information obtained from this study may inform improvements in practice and future research.

***I am inviting Registered Nurses who provide bedside care in the inpatient setting to participate in this study. Participants must be*** (1) full-time RNs in a hospital inpatient unit (2) having at least three months experience with MediTech electronic documentation, and (3) able to work any shift, any day. I am not able to enroll nurses

who are (1) working as part-time RNs, and (2) RNs who plan to be absent within one-two weeks after the lecture provided as part of the study.

If you agree to participate, please reply, and I will come and speak with you about the study. You will be randomly assigned to either a data quality educational session or a nursing ethics class. The study will take 60 minutes of your time for which you will earn 1-hour CEU. You can attend the session during your normal working hours if time permits.

If you are interested in participating in the study or have questions before participating, please contact me at [Elena.Dragan@hcahealthcare.com](mailto:Elena.Dragan@hcahealthcare.com) or call/text me at 713-212-9946.

This research is supervised by the TWU College of Nursing. Dr. Ann Malecha is the supervising faculty member and you may contact her at 713-794-2725 or [amalecha@twu.edu](mailto:amalecha@twu.edu).

Thank you in advance,

Elena Dragan, MSN, MS, RN, Texas Woman's University

## Recruitment Follow-Up Email

To: Registered Nurses at Clear Lake Reginal Medical Center (CLRMC),

I am following up on an email I sent you recently regarding participation in a research study.

I am a Ph.D. student in the College of Nursing at Texas Woman's University and one of the clinical educators at CLRMC. I am researching the quality of the data documented in our electronic health records (EHRs) for my dissertation.

I am conducting a study titled, *evaluating an intervention to improve registered nurses' adherence to the data quality (DQ) components of accuracy, completeness, timeliness, and objectivity (ACTO) in electronic health records*. The study has been approved by CLRMC and by the Texas Woman's University Institutional Review Board (IRB).

The purpose of this study is to gain an understanding of data quality related to our daily practice. This study is expected to contribute to increased awareness of our daily documentation and a better understanding of the components of data quality. The information obtained from this study may inform improvements in practice and future research.

***I am inviting Registered Nurses who provide bedside care in the inpatient setting to participate in this study. Participants must be*** (1) full-time RNs in a hospital inpatient unit (2) having at least three months experience with MediTech electronic documentation, and (3) able to work any shift, any day. I am not able to enroll nurses

who are (1) working as part-time RNs, and (2) RNs who plan to be absent within one-two weeks after the lecture provided as part of the study.

If you agree to participate, please reply, and I will come and speak with you about the study. You will be randomly assigned to either a data quality educational session or a nursing ethics class. The study will take 60 minutes of your time for which you will earn 1-hour CEU. You can attend the session during your normal working hours if time permits.

If you are interested in participating in the study or have questions before participating, please contact me at [Elena.Dragan@hcahealthcare.com](mailto:Elena.Dragan@hcahealthcare.com) or call/text me at 713-212-9946.

This research is supervised by the TWU College of Nursing. Dr. Ann Malecha is the supervising faculty member and you may contact her at 713-794-2725 or [amalecha@twu.edu](mailto:amalecha@twu.edu). Thank you in advance, Elena Dragan, MSN, MS, RN, Texas Woman's University.

APPENDIX K  
Intervention Schedule

611- Stroke 6W CT; 613-6E CT; 622-Obs 1South CT; 623 – Med Inter 6HT; 625-CardiacMed -5HT; 650- ICU – 3 MT  
 632 – Onco 5 South CT; 693- Rehab 5 East CT; 630- CV Inter I 3HT; 631-630- CV Inter II 3HT; 634- IMCU 4West CT; 651- Neuro/Tr.  
 2 MT; 653- CVICU-2HT; 654-CCU- 3HT



## March 2018

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19 632.693.630.631.634, 651.653.654	20 632.693.630.631.634, 651.653.654	21 632.693.630.631.634, 651.653.654	22 632.693.630.631.634, 651.653.654	23 632.693.630.631.634, 651.653.654	24 632.693.630.631.634, 651.653.654	25 632.693.630.631.634, 651.653.654
26 632.693.630.631.634, 651.653.654	27 632.693.630.631.634, 651.653.654	28 632.693.630.631.634, 651.653.654	29 632.693.630.631.634, 651.653.654	30 632.693.630.631.634, 651.653.654	31 632.693.630.631.634, 651.653.654	

611- Stroke 6W CT; 613-6E CT; 622-Obs 1South CT; 623 – Med Inter 6HT; 625-CardiacMed -5HT; 650- ICU – 3 MT  
 632 – Onco 5 South CT; 693- Rehab 5 East CT; 630- CV Inter I 3HT; 631-630- CV Inter II 3HT; 634- IMCU 4West CT; 651- Neuro/Tr.  
 2 MT; 653- CVICU-2HT; 654-CCU- 3HT



## April 2018

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
						1 632.693.630.631.634, 651.653.654
2 632.693.630.631.634, 651.653.654	3 632.693.630.631.634, 651.653.654	4 632.693.630.631.634, 651.653.654	5 632.693.630.631.634, 651.653.654	6 611.613.622.623, 625.650	7 611.613.622.623, 625.650	8 611.613.622.623, 625.650
9 611.613.622.623, 625.650	10 611.613.622.623, 625.650	11 611.613.622.623, 625.650	12 611.613.622.623, 625.650	13 611.613.622.623, 625.650	14 611.613.622.623, 625.650	15 611.613.622.623, 625.650
16 611.613.622.623, 625.650	17 611.613.622.623, 625.650	18 611.613.622.623, 625.650	19 632.693.630.631.634, 651.653.654	20	21	22

APPENDIX L

Continuing Nursing Education Template

CERTIFICATE OF SUCCESSFUL COMPLETION

***Name of Approved Provider***  
***Address of Approved Provider***  
***(PROVIDER ID #: \_\_\_\_\_)***

*Certifies that*

***Name of Participant***

*Has been awarded \_\_\_\_\_ contact hours for*

***Title of Your Education Activity***

*This the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_*

***Location: Location of Activity Presentation***

***(Name of Approved Provider)*** is an approved provider of continuing nursing education by the Texas Nurses Association - Approver, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.