The Impact of an Integrated Electronic Health Record Adoption on the Quality of Nursing Care Delivered

AnneMarie Walker-Czyz
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The Impact of an Integrated Electronic Health Record Adoption on the Quality of Nursing Care Delivered

Abstract
Computerized documentation is not a new concept, but little is known about nurse's adoption to this innovation and the effects on the nurse practice environment. The purpose of this research was to investigate the impact of an EHR tool on the quality of nursing care delivered. A quantitative, retrospective analysis using an interrupted time series model of a large data set was conducted from 2010 and 2013. The study showed that the use of an integrated EHR tool in nursing practice impacts many quality outcomes such as hospital acquired conditions, costs, and nurse turnover. The study showed with diffusion of innovations that EHR adoption over time can impact quality and cost measures negatively or positively followed by an improved state or return to pre-implementation period. The study added to the existing body of research and contributed to the formation of an evidenced based model to support organizations innovation adoption of an EHR implementation. This study further clarified the practice environment of RNs. The implications for practice include recommendations to include nurses in innovation adoption, modifications of staff models to promote nurse retention during innovation adoption, supportive leadership practices, the use of evidenced based computerized tools, and additional research is necessary to understand the clinical practice environment and nurse satisfaction. The diffusion of innovations, such as the implementation of an integrated EHR, using servant leadership principles to support nursing care delivery, improves the overall performance of acute care hospital environments by enhancing decision making for registered professional nurses.

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The Impact of an Integrated Electronic Health Record Adoption
on the Quality of Nursing Care Delivered

By

AnneMarie Walker-Czyz

Submitted in partial fulfillment
of the requirements for the degree
Ed.D. in Executive Leadership

Supervised by
Dr. Dianne Cooney-Miner

Committee Member
Dr. Susan Schultz

The Ralph C. Wilson, Jr. School of Education
St. John Fisher College

August, 2014
Dedication

My desire has been to contribute to this great profession of nursing I hold sacred in my life, the completion of this goal is only possible with the love, dedication, and encouragement of so many. I wish to thank my dissertation chair, Dr. Dianne Cooney-Miner, for all of her mentorship and support in taking a concept and making it a reality. I am privileged to have worked with a nurse leader who demonstrates unwavering commitment to advancing the profession and her students, your guidance both personally and professionally has made such a difference in my life. To my committee chair, Dr. Susan Schultz, your insight and encouragement for my writing and research provided me with the belief that I could actually accomplish this goal. Dr. Marie Cianca, thank you for always being available and providing me with direction at a moment’s notice. To one of the most brilliant minds I’ve ever known, Dr. Bruce Blaine, thank you for your support with my methodology and for the countless hours you spent with me.

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To all my friends and colleagues at St. Joseph’s Hospital Health System, you have given me continual energy through your encouragement and belief in me. My heartfelt thank you to Kathryn H. Ruscitto, President and CEO, and mentor to me in many ways, I
am so grateful for your support and the opportunities you’ve given me, this truly would not have been possible without you.

Last, to my family, you have been by my side the longest, to challenge and encourage me tirelessly. To my parents, Richard and Judith Walker, I love that you always believe I can do anything even when it may seem impossible, I hold on to all you’ve given and provided me. To my husband Jeremy, a true life-long partner who has stood by me once again to achieve my hopes and desires, his love and support has meant more than words can convey. To my beloved children, Joseph and Sean, who have been my light and inspiration always. Finally, I thank God for His faithfulness to complete the work He started, I know every good and perfect gift comes from You, the Father of light.
Abstract

Computerized documentation is not a new concept, but little is known about nurse’s adoption to this innovation and the effects on the nurse practice environment. The purpose of this research was to investigate the impact of an EHR tool on the quality of nursing care delivered. A quantitative, retrospective analysis using an interrupted time series model of a large data set was conducted from 2010 and 2013.

The study showed that the use of an integrated EHR tool in nursing practice impacts many quality outcomes such as hospital acquired conditions, costs, and nurse turnover. The study showed with diffusion of innovations that EHR adoption over time can impact quality and cost measures negatively or positively followed by an improved state or return to pre-implementation period. The study added to the existing body of research and contributed to the formation of an evidenced based model to support organizations innovation adoption of an EHR implementation. This study further clarified the practice environment of RNs.

The implications for practice include recommendations to include nurses in innovation adoption, modifications of staff models to promote nurse retention during innovation adoption, supportive leadership practices, the use of evidenced based computerized tools, and additional research is necessary to understand the clinical practice environment and nurse satisfaction.

The diffusion of innovations, such as the implementation of an integrated EHR, using servant leadership principles to support nursing care delivery, improves the overall
performance of acute care hospital environments by enhancing decision making for registered professional nurses.
Biographical Sketch

AnneMarie Walker-Czyz is currently the Senior Vice President for Operations, Chief Operating Officer and Chief Nursing Officer at St. Joseph’s Hospital Health System in Syracuse, New York. She attended St. Joseph’s College of Nursing from 1997 to 1999 and received her Associates in Applied Science degree. After completing her registered nurse license exam, she began working at the hospital in the cardiac step down unit and started her Bachelors of Science in Nursing at Upstate Medical University in Syracuse. She completed her bachelor’s degree in 2003 and accepted a position as a registered nurse staff educator. At that time, she started her Master’s in Science degree at Upstate Medical University. AnneMarie was promoted to a nurse manager position on a medical surgical teaching service unit in 2006. At the end of 2006 she was promoted to the Director of Critical Care and Cardiac Services, she then completed her Master of Science in Nursing and Clinical Nurse Specialist in Critical Care in 2007. In 2008, AnneMarie was appointed as the Vice President of Clinical and Educational Services and Chief Nursing Officer for St. Joseph’s Hospital Health System and in 2014 appointed to Senior Vice President of Operations. She began her doctoral studies at St. John Fisher College in the spring of 2012. AnneMarie conducted research studying the topic of innovation adoption on health care organizations. The innovation of study for her research was the implementation of an integrated electronic health record and the impact on nursing quality delivered from 2010-2013 under the direction of Dr. Dianne Cooney-Miner.
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Chapter 1: Introduction

Introduction and Background

The demand for healthcare services has steadily increased over past decades and healthcare systems are faced with unprecedented challenges to meet the demand. The challenges include strained financial resources, socio-demographic changes, rising healthcare costs, complicated health conditions, higher public expectations, and complex government directives to meet the community demands for accessible, affordable, quality healthcare (Ankner, Coughlin, & Holman, 2010). As a result of the complex healthcare environment, the majority of organizational leaders are on a quest to discover solutions (Hagbaghery, Salsali, & Ahmadi, 2004). The concept of innovations adoption in healthcare has evolved from a novelty level need to promoting organizational effectiveness. Although healthcare environments might appear to be major consumers of a wide range of innovations, in reality, they are more innovation generators than adopters (Salge & Vera, 2009). The adoption of new clinical behaviors by individual clinicians and healthcare systems is multifaceted, and is to be considered a process.

The use of computerized technology to retrieve and capture healthcare information has been reported since the 1960s. In the 1980s, it was proposed that computerized nursing documentation would provide medical orders, nursing interventions, and capture patient’s responses to the provision of care (Lee, 2006). Computerized documentation is not a new concept, and little is known about nurses’
adoption, their perceptions, and the effects on the nurse practice environment. Over the past decade there has been a rapid increase in the application of Electronic Health Records (EHR). The Institute of Medicine’s (IOM) aim for the 21st century health care system is to provide care that is safe, effective, patient centered, timely, efficient, and equitable (Carlson et al., 2010). The potential benefits of EHR adoption include: real time patient information, limiting redundant workflow, standardization of care, increased productivity, reduction of errors, and more timely accurate communication among all health care providers.

As health care institutions seek EHR adoption, it is essential to ensure that a cost effective strategy be developed that includes provider specific applications. An estimated 4.7 billion dollars was spent nationwide in 2009 on information technology (IT) implementations, and this is anticipated to increase to 6.8 billion dollars by 2014. The significance of healthcare IT at the national level is noted in the American Recovery and Reinvestment Act of 2009, where 19 billion dollars was allocated for distribution of funds to healthcare institutions that report comprehensive adoption (Carlson et al., 2010). The emerging problem for healthcare administrators is that minimal consensus exists on adoption of computerized documentation to ensure that the overall goals of safe, efficient care are achieved.

The introduction of computers in the nursing practice environment has significantly affected the actual and perceived methods for providing patient care. Historically, the primary focus for the discipline of nursing has been patient care centered, with a secondary focus on adoption of technology. Computerized documentation systems have challenged the methods of nursing practice by requiring
nurses to document, in detail, their provision of care. Nurses document changes in the patient’s condition and the patient’s responses to care interventions, as compared with the historic method of a narrative summary that used hand written documents in the medical record to describe the patient’s overall health. It is imperative for modern nursing practice to consider the effect of the explosion of information technology on the practice of Registered Professional Nurses (RN), and to develop creative strategies using this technology to deliver care in this new environment (Lee, 2004).

Many healthcare improvements are initiated to enhance an organizational leader’s knowledge of the nurse practice environment. The understanding of nurse workflow is determined through practice that is defined and measured (Cornell, Herrin-Griffith, et al., 2010). Nurse workflow has been found to be chaotic as a result of the inability to complete intended tasks, more specifically, nurse work flow has been generalized as, “there is little flow in nurse workflow” (Cornell, Herrin-Griffith, et al., 2010 p. 366). Necessary critical thinking skills can be severely inhibited under the current practice environment. The nurse practice environment and the promotion of clinical decision making are important areas to consider for securement of quality care delivery.

Clinical decision making can be defined as the nurse’s participation in their usual clinical practice tasks (Hoffman, Donoghue, & Duffield, 2004). The role of the Registered Professional Nurse has recently changed, and the result is layering of additional responsibilities from the increased demands placed on the role (Mrayyan, 2004). The role changes are a result of high staff vacancy rates and downsizing of support services, which in turn cause nurses to acquire non-clinical tasks. The non-direct care tasks include clerical and environmental functions (Mrayyan, 2004). Understanding
the nurse practice environment is critical in the provision of quality nursing care. Greater nurse autonomy in decision making has been linked to increased job satisfaction and retention in the workplace (Mrayyan, 2004). The effects of EHR adoption can promote enhanced clinical decision making for nurses.

The goal for future research is to study the impact of an integrated EHR on the quality of nursing care. The existing literature, while vast, focuses on the implementation and sustainability of computerized documentation. This paper will describe the goals of the study, summarize how the goals will relate to existing knowledge, and address what is unknown about the effects of computerized documentation on nurse’s workflow.

Computerized documentation was developed and implemented on a premise that it would capture a comprehensive picture of the care provided to a patient while improving nurse workflow. Research has been conducted to investigate the current assumptions around clinical documentation programs. Perceptions in practice of EHRs include workflow problems, fragmentation of documentation and increased time needed away from direct patient care. Provider variations and solid systems of care can potentially prevent nurses from providing the artful direct patient care service to their patients.

The greatest advantage of exploring the effects of computerized documentation is how it affects nurse’s workflow. Recent literature on nurse workflow highlights that the number of activities and the frequency of interruptions within a nursing shift reflects that there is no flow in nurse workflow (Cornell, Herrin-Griffith, et al., 2010). Computerized documentation has the potential to enhance the quality and safety of care delivery, and the organization of nurse workflow following adoption of the tools. Technology must be
integrated into the nurse’s workflow. Future research is needed to explore successful integration of the EHR into workflow of direct care nursing. The belief is that computerized nursing documentation is critical to the future of healthcare and that the nursing profession must engage in its use to proactively solidify their role.

The conditions in acute care medical surgical units will endure the greatest burden of successful implementation (Cornell, Herrin-Griffith, et al., 2010). In order to provide excellent patient care, and maintain control over their work environment, a combination of changes must occur, including redesign of nursing units for efficiency, new technologies that can be used at the bedside, and a modification of certain nursing activities. A combination of efficient designs for units, new technology, role re-definition, and a modification of activities can be altered or reallocated for nurses to increase time for patient care and gain more control (Cornell, Herrin-Griffith, et al., 2010). The adoption of computerized documentation is directly linked to time for the provision of care. The impact of time is dependent on the RN’s perception, workflow, device choice, and standardized care plans of EHR. Research is lacking in identifying the type of workflow designs that will best promote computerized documentation. In addition, the largest gap in the literature is the accuracy of nursing documentation that is captured. Very little is known regarding the characteristics of optimal documentation of care delivery.

**Problem Statement**

The evaluation of the nurse practice environment given the introduction of technology is useful information in assessing performance, efficiency of care, and resource planning and allocation (Cornell, Riordan, et al., 2010). Nurse workflow and the
quality of nursing care delivery may improve with the adoption of a comprehensive, integrated Electronic Health Record. System adoption is critically important to increase the ease and accessibility of information to provide time for nurses to analyze, synthesize, decide, and deliver patient care (Cornell, Riordan, et al., 2010).

**Theoretical Rationale**

Organizational quality defects can be caused in part by system failures; this has led to an emerging focus on organizational aspects for improving the quality of health care (Rhydderch, Elwyn, Marshall, & Grol, 2004). Although the literature does not delineate a single method for the adoption of practice change in health care, there is a theory that outlines common characteristics that an individual experiences (Fitzgerald, Ferlie, Wood, & Hawkins, 2002). Research conducted on the effects of an integrated EHR on the quality of nursing care delivery can be constructed through the Diffusion of Innovations (DOI) theory. DOI is a theory that has summary characteristics shared throughout the process of innovation adoption (Diffusion of Innovation Theory, 2005).

The adoption of innovations and incorporation of evidenced-based research into health care systems are challenging yet necessary commitments. The Agency for Healthcare Research and Quality Health Care Innovations Exchange (AHRQ) has emphasized the need for innovations in healthcare to effectively communicate and disseminate successful adoption of technology or new clinical practice (Clutter, 2009). DOI has been applied successfully to multiple health care advances and offers a solution to the complex question of why and how some evidenced-based practice outcomes are accepted and disseminated and others are resisted. DOI is defined as, “the process by which an idea, practice, or object perceived to be new by an individual or other unit is
adopted and communicated through certain channels over time among the members of a social system” (Rogers, Singhal, & Quinlan, n.d., p. 2).

Innovativeness is the dependent variable in the DOI theory. The continuum (degree and rate) of individual or a unit’s ability to respond to innovations adoption is often divided into categories, referred to as adopter categories (Rogers et al., n.d.). Adopter categories are defined as innovators, early adopters, early majority, late majority, and laggards (Rogers et al., n.d.). The following are the four main components of the theory: (a) innovation, an idea, practice, or object that is perceived as new by an individual, (b) communication, channels, the method used to provide understanding to the individual, (c) time can be described in three ways: innovation-decision process, relative time in which the innovation is adopted, and, (d) the rate of innovation adoption. Social system is the final component in DOI theory. The social system is, “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (Diffusion of Innovation Theory, 2005 p. 1).

DOI has two processes, adoption and decision. Adoption is defined as a mental progression when an individual or unit first hears of the change to final acceptance or adoption of the information. There are five stages of the adoption process: awareness, interest, evaluation, trial, and adoption. The innovation-decision process is defined as the manner the individual passes through the innovation to decision, and there are five stages to further explain the process. Stage one is when the individual has initial knowledge of the innovation; stage two is the point when the individual develops an opinion of the innovation; stage three is the individual decides to accept or reject the innovation; stage four is the implementation of the new innovation; and stage five is to confirm the
decision to innovate. There are factors that impact an individual’s decision to innovate. These prior decision making factors include previous practice, the individual’s feeling of a need or problem, individual’s level of innovativeness, and perceived norms of an individual or social system (Diffusion of Innovation Theory, 2005). DOI is a widely known theoretical approach. The theoretical approach is useful in determining the adoption of clinical behaviors, both those specific behaviors that affect clinical practice directly, as well as factors that will require additional attention for diffusion to occur (Sanson-Fisher, 2004).

Computerized documentation has the potential to enhance the quality and safety of care delivery if the diffusion of innovations is secured. Future research is needed to explore successful integration of an EHR using the diffusion of innovations model (Von & Naden, 2008). DOI theory has been utilized throughout a variety of research studies, and is applicable to the topic of interest. Innovations, such as computerized documentation, are adopted when individuals recognize the change is applicable, easily incorporated into practice, can be tested and changed, and clinicians are visualized using the innovations (Swanson-Fisher, 2004). DOI provides a viable theoretical framework to further research the effects of a fully integrated EHR adoption on the quality of nursing care.

**Statement of Purpose**

The purpose of the proposed research is to measure the impact of an EHR innovation adoption on the quality of nursing care delivered. Adoption of EHR innovations increases nurses time to provide direct patient care, and improves the quality of nursing care by decreasing hospital acquired conditions and nurse turnover.
**Research Questions**

This study investigates the impact of EHR on nursing care. The research questions are as follows: What is the impact of EHR on quality of nursing care delivered, hospital acquired falls, pressure ulcers, ventilator associated pneumonias, central line associated blood stream infections, catheter associated urinary tract infections, nurse turnover, and work hours (measured in overtime and HPPD)? A research question is an interrogative statement that narrows the statement of purpose to a specific question (Creswell, 2002). Weaknesses or potential problems that may affect the results of the study are the use of administrative retrospective data. The use of administrative data in research is challenged when collection methods have not been controlled. In addition, an anticipated weakness that may affect the results of the study is minimal concurrent validation of research findings. The research methodology will attempt to mitigate the stated challenges and weaknesses.

**Significance of the Study**

The largest portion of the healthcare workforce is registered professional nurses (RNs). Nurses are responsible for the implementation of caring and scientific approaches to deliver patient care services. The dynamic environment of healthcare requires nurses to be competent, clinical decision makers with the ability to respond to the myriad of behavioral and physiological conditions of patients across the continuum (Hagbaghery et al., 2004). Healthcare institutions have a growing interest in further understanding how to improve clinical decision making (Stewart, Standsfield, & Tapp, 2004). In addition, the healthcare environment is complex and researchers are attempting to further understand how the environment impacts nurses.
Organizational leaders are encouraged to examine nursing workflow to enable more cost effective care. Increased knowledge of nurse workflow provides a foundation for how the role needs to evolve with the ever changing healthcare environment (Cornell et al., 2010). A nurse workflow study demonstrated that patient assessment, computerized documentation, and communications were the most frequent activities. Nurse workflow has been found to constantly move from task to task in random patterns. Frequent switching of care delivery activities can affect performance, especially on processes that demand critical thinking. Computer use that is not part of ongoing nurse workflow, but only accessed periodically can be a contributing factor to activity switching and have implications on patient care safety and effectiveness. Future research to closely examine nurse workflow with the introduction of new technology such as computerized documentation is necessary. Without further research to investigate technology integration the current environment is likely to lead to frustrations, inefficiencies, low productivity, and increase the risk for error (Cornell, Riordan, et al., 2010).

Computerized documentation adoption research suggests even though mastering the technology can increase indirect time, long term integrated EHRs should be a significant time savings (Cornell, Riordan, et al., 2010). However, there has been evidence to the contrary. Nurses’ perceptions are that EHR adoption impairs their workflow because the increased documentation expectations take time from direct patient care activities. Recent studies demonstrated that the introduction of a computerized medication documentation system only reduced paper-based activities. The communication and time with the patient was unchanged. Recommendations for future
research when conducting observational studies on nurse workflow activities is to utilize a small activity set (Cornell, Riordan, et al., 2010).

EHRs have the potential to transform quality improvement processes for healthcare organizations. EHRs can support multifaceted interventions with integrated patient information that support providers in performing quality improvement initiatives (Persell et al., 2011). As the United States works to achieve higher performance in the provision of healthcare services, it is important that research studies on multifaceted EHRs are based in quality improvement methods. The “implementation of a multifaceted QI [Quality Improvement] intervention using EHR tools to improve quality measurement, and the accuracy and timeliness of clinician feedback improved performance and/or accelerated the rate of improvement for multiple measures simultaneously” (Persell et al., 2011, p. 124). Effective EHR system implementations can be accomplished, and lead to greater individual ownership of innovation adoption. EHRs need to be visionary and presented as a change management endeavor. The feasibility to successfully implement an EHR relies on insightful leadership with a vision to improve hospital performance through the transformation of work practices. Cost savings through EHR implementation should be considered through improvements in work processes (Takian, 2012).

Over the past few years the federal government has made a significant effort to reform healthcare organizations through health information technology adoption. The federal standards are defined by a set of quality and financial outcomes captured in an EHR, commonly known as “meaningful use,” under the Health Information Technology for Economic and Clinical Health HITECH Act (Buntin et al., 2011). Although there
have been high hopes for EHR adoption to improve healthcare performance, the evidence has been discouraging. Although EHR adoption has proven to be significantly more complex to implement for hospitals, acceleration of adoption throughout hospital systems is necessary to fill the gaps (Buntin et al., 2011). Early findings in success with EHR adoption demonstrate a very modest improvement for hospitals performance. Hospitals need to consider advanced systems to achieve meaningful use expectations (Buntin et al., 2011).

“The evidence regarding the impact of EHRs on quality of patient care is undeniably mixed despite estimates that these technologies could save the US healthcare systems more than 81 billion dollars a year” (Kutney-Lee & Kelly, 2011, p. 466). There are specific elements of the EHR system adoption that have been associated with improved quality outcomes. Improvements in quality outcomes include lower mortality rates, decreased hospital acquired conditions, and lower cost of care. Nurses working in institutions with an EHR reported less risk to patient safety issues, and a potential to improve the coordination of care delivery. Further research is necessary to validate early findings that improvements in nursing care delivery are sustainable with EHR integration. In addition, the role of the nurse leader is a critical component to successful EHR adoption and should be explored further in research (Kutney-Lee & Kelly, 2011).

Nursing is a complex profession that requires both competence and professional service delivery through caring and compassionate behaviors (Jenkins & Stewart, 2010). In the United States there are over 2.2 million RNs; the profession is the largest specialty amongst the healthcare disciplines, and understanding factors that impact job performance is essential in sustaining our healthcare system. The implications for
practice suggest that the responsibility for care giving is not with the direct care nurse alone, but institutionally as well. “Investments in human capital can potentially produce even greater returns through the satisfaction and retention of employees and the achievement of higher productivity measures” (Jenkins & Stewart, 2010, p. 53).

The statement of the need for further research, in nurse work flow and the potential for improvement in quality of nursing care delivery with the adoption of an Electronic Health Record, is significant for future study because of the current mixed findings in the literature. In addition, EHR adoption is considered to be a national intervention to support the improvement of overall healthcare management. The use of an EHR has the potential to improve the overall quality and cost management of patients in the hospital setting; further research is necessary to verify these assumptions.

There are two hypotheses of study. The first hypothesis of study is that nursing quality, satisfaction, and costs improve over time once the innovation is integrated into nurse workflow. The second hypothesis of study is that the implementation of an EHR impacts quality, safety, and nurse satisfaction during the onset of the innovation adoption period followed by stabilization (or a return to baseline). A retrospective analysis, using an interrupted time series (ITS) model of a large data set to analyze data at the point of nursing care one year pre-implementation, at the point of implementation, and one year post implementation through the following research questions:

1. What are the effects on the quality of nursing care delivered including hospital acquired falls, hospital acquired pressure ulcer rates, ventilator associated pneumonia, central line associated blood stream infections, catheter associated
urinary tract infections, nurse retention, and costs of care pre, during, and post implementation of an EHR?

2. What is the impact of the integration of EHR tools in direct care nurse workflow on nurse satisfaction over time in one acute care hospital?

A study designed to investigate the effects of EHR adoption and the impact on nurse quality and satisfaction will add to the existing body of research and contribute to the formation of an evidenced based model to support organizations innovation adoption such as the implementation of an EHR, and further clarify the practice environment of RNs.

Definitions of Terms

Electronic health record (EHR). A systematic collection of electronic health information regarding an individual patient or populations. The collection or record is a digital format that has the ability to be shared throughout a healthcare institution, enterprise or participate in a larger network or information exchange system. EHRs can include a wide range of data: demographics, medical history, medication and allergies, immunization status, laboratory and imaging results, vital signs, and billing information. Evidenced based guidelines support elements of patient demographics for the purpose of tracking patient outcomes through panels of patient conditions linking them to the appropriate providers (Tolar & Balka, 2012).

Nurse workflow. Activities performed by nurses that result in the ongoing care and improvement of the health conditions of patients. There are macro level activities, such as direct versus indirect care. These levels of activities have relatively few categories and are centered on nursing process, (assess, diagnose, plan, implement,
evaluate). Detailed analysis of nurse workflow may require additional categories. The Institute of Healthcare Improvement (IHI) initiative “Transforming Care at the Bedside” (TCAB) defines more than 70 nursing activities to be measured (Cornell, Riordan, et al., 2010).

**Innovation adoption.** An idea, practice, or object perceived to be new by an individual or other unit is adopted. Innovativeness is the dependent variable in the DOI theory. The continuum (degree and rate) of individual or unit’s ability to respond to innovations adoption is often divided into categories, referred to as adopter categories (Rogers et al., n.d.). Adoption is defined as a mental progression when an individual or unit first hears of the change to final acceptance or adoption of the information. There are five stages of the adoption process: awareness, interest, evaluation, trial, and adoption. The innovation-decision process is defined as the manner the individual passes through the innovation to decision (Diffusion of Innovation Theory, 2005).

**Nurse decision making/autonomy.** The profession of nursing is responsible for the constant surveillance of patient’s conditions. As a result, the need for efficient operations in healthcare organizations has resulted in advocating for nurse participation in decision making related to patient care, working conditions, and the organizational policy (Jaafarpour & Khani, 2011). Participation in decision making for RNs has been associated with positive patient outcomes (Jaafarpour & Khani, 2011). Decisional involvement is defined as, “The pattern of the distribution of authority for the decision and the activities that govern the nursing policy and practice environment” (Jaafarpour & Khani, 2011, p. 16). Clinical nurses rate autonomy as the most significant factor for
providing quality care. There is a wide range of definitions regarding nurse autonomy. A summary definition is as follows.

Nurses described autonomy as their ability to accomplish patient care goals in a timely manner by using their knowledge and skills to understand and contribute to the overall plan of care; assess patient needs and conditions; effectively communicate concerns and priorities regarding patient care; and access and coordinate the resources of the multidisciplinary team (Stewart et al., 2004, p. 443).

**Quality outcomes.** For the purpose of this research study, quality outcomes is defined as nurse sensitive indicators, nurse satisfaction, patient satisfaction, nurse retention, and costs.

**Nurse sensitive quality indicators.** The American Nurses Association (ANA) state nursing-sensitive indicators reflect the structure, process and outcomes of nursing care. The structure of nursing care is measured by the supply of nurses, the education, and certifications. Patient outcomes that are determined to be nursing sensitive are those that are improved by the quality of care delivery such as pressure ulcers, falls, and intravenous infiltrations (American Nurses Association, 2013).

**Hospital acquired conditions.** A hospital acquired condition is a medical condition or complication that a patient develops during a hospital stay, which was not present at admission. In most cases, hospitals can prevent hospital acquired conditions when they provide care that is evidence based (McNair, Luft, & Bindman, 2009).
Chapter Summary

Historically, EHRs have been designed to capture clinical tasks during episodes of care throughout the continuum of healthcare services. However, emerging focus is on the adoption of an integrated EHR, and has been reported to increase the quality and safety of patient care. The potential benefits of EHR adoption include: real time patient information, reducing redundant workflow, standardization of care, increased productivity, reduction of errors, and more timely accurate communication among all health care providers. The challenges facing healthcare institutions and the profession of nursing are multifaceted. The integration of an EHR has the potential to improve the efficiency of care delivery. As nursing practice increases in complexity, EHR adoption can provide information to improve workflow and support critical thinking and complex decision making (Cornell, Riordan, et al., 2010).

DOI theory has been utilized throughout a variety of research studies, and is applicable to the topic of interest. Innovations, such as computerized documentation, are adopted when individuals recognize the change is applicable, easily incorporated into practice, can be tested and changed, and clinicians are visualized using the innovations (Swanson-Fisher, 2004). DOI provides a viable theoretical framework to further research the effects of a fully integrated EHR adoption on the quality of nursing care.

The following chapters will analyze the relevant empirical research literature; explain the research methodology used, including the research context, participants, instruments used for data collection, procedures for data collection and analysis, provide data analysis and findings along with a summary of the results by research question. Finally a discussion and interpretation of the results of this study will be presented with
strengths and limitations of the study, recommendations for future research, and implications of the findings on research, education, practice, and leadership.
Chapter 2: Review of the Literature

Introduction

Innovation adoption or integrating leading practices, such as technology, into healthcare systems has been the primary answer for improving the United States (U.S.) healthcare systems for the past decade. The nation’s healthcare systems have been struggling with the magnitude of problems facing the current environment. Problems include rising costs, uninsured patients, unequal access to services, staff shortages, productivity losses, fragmentation in the continuity of care, and ultimately, an increased demand for services with an inability to meet patient’s expectations. The most serious of problems is the poor quality of care. The Institute of Medicine (IOM) report, 1999, stated nearly 100,000 preventable deaths occurred in U.S. hospitals (Kohn, Corrigan, Donaldson, & Institute of Medicine, 1999).

Innovation adoption is the process by which an innovation in practice, policy, or technology is disseminated throughout an organization. An explanation for slow innovation adoption in healthcare organizations is a result of the complex practice environment (Nembhard, Alexander, Hoff, & Ramanujam, 2009). The adoption of computerized documentation, an electronic health record (EHR), is an example of an innovative solution to improve integration of services across complex continuums of care. The success of innovation adoption, such as an integrated EHR, is dependent upon
an organization’s ability to unify the purpose of the adoption, and support the practice environment during implementation (Nembhard et al., 2009).

The following paper will begin with an overview of innovation adoption in healthcare organizations followed by a brief introduction on the nurse practice environment, decision making and engagement of nurses. An in depth review of the literature was conducted to examine the empirical research of the impact of integrated EHR adoption on the quality of nursing care. The data bases used were, PubMed, CINAHL (Cumulative Index of Nursing and Allied Health Literature), EbscoHost, Medline, and Google Scholar. The parameters included peer reviewed articles from 2003 to 2013 using the following keywords: nursing care, decision making, electronic health record, innovation adoption, and acute care settings. Articles that were excluded were primarily research that did not directly investigate innovation adoption and the effects on clinical practice and/or patient outcomes.

The scientific research is categorized into four areas: (a) innovation adoption in healthcare organizations (b) factors impacting the nurse practice environment (c) decision making characteristics of nurses, and (d) impact of implementation of EHR on quality outcomes. Integrative reviews of the literature publications were excluded from the paper. The paper concludes with a methodological summary of the research, a review of the gaps in the literature and recommendations for future research.

**Background and Context**

Diffusion of innovations is a major challenge in healthcare organizations. Healthcare is among the most endowed of all industries with its scientific knowledge, but clinical science often progresses slowly (Berwick, 2003). The failure to utilize leading
science in practice can result in increased cost and patient harm events. The science of diffusion of innovation can be focused by three major categories: (a) perception of the innovation; (b) characteristics of people who adopt the innovation or don’t and; (c) contextual factors such as communication channels, rewards, and organizational leadership support (Berwick, 2003).

**Innovation Adoption**

The adoption and utilization of computers in patient care settings represents an innovative change in nursing practice. Nurses have long since used computers to analyze data points such as lab work, or requested orders to be completed as in a lab study, but the integration of computerized documentation while providing patient care is a recent change for the profession of nursing. Nurses represent the largest specialty of the health professions. Their perception of computer use is critical to success of implementation (Lee, 2004). Using the Rogers Diffusion of Innovation (DOI) model provides a process to explore the factors contributing to how an innovation was rejected or accepted by a group of individuals. Lee (2004) explored the perception of twelve nurses from three respiratory intensive care units. A qualitative, one-on-one study was conducted with in depth interviews, compared to DOI’s five characteristics. Following approval of the Institutional Review Board (IRB), nurses who were early adopters to the new nursing computerized care planning tool were recruited to participate in the study. A constant comparative analysis was used and central themes emerged. The themes supported nurse’s behaviors with computerized adoption aligned with the five components of Rogers DOI model: relative advantage, compatibility, complexity, trialability, and observability. The nurses provided feedback that the relative advantage of computerized
documentation was better organized; however stress was raised when delays in the charting process occurred. The compatibility was described by the nurses as improvements in their assessment sequences and linkages between their care plans and patient care. An example related to complexity included nurses’ descriptions of the system as user-friendly, and requiring less thinking time in how or where to document. The trialability theme was described as having inadequate nursing content, and the format was rigid. Observability was described by the volume of documentation supported accreditation standards and exemplified professionalism (Lee, 2004).

The strength of the study was the design and the results could serve as references for future studies to explore the Rogers DOI model. A study limitation was the small sample size. Future studies are necessary to explore the diffusion process and organizational variables that affect adoption (Lee, 2004).

Computerized technology in nursing practice has been reported as early as the 1960s (Lee, 2006). Researchers have recommended that further understanding of the nurse’s perceptions and quality of patient care delivery is necessary. Lee (2006) aimed to explore nurses’ perceptions of care planning using a computerized system. The use of a descriptive, qualitative approach with one-on-one interviews of 20 nurses was conducted. The major interview question was, “What do you think the content of the computerized care plan provided in making care plans?” (Lee, 2006, p. 1378). A content analysis of the interviews yielded three concepts of how the computerized tool influenced the nurses’ documentation process. The nurses used the tool in these ways: (a) as a memory aid, (b) as a learning tool for patient care, and (c) as an instrument to modify the care plan from
ongoing nurse assessments of the patient. Scripted examples from each nurse were provided to support the findings (Lee, 2006).

The strengths of the study were that the findings added new information to existing research by indicating how nurses felt using computerized care planning. The weakness of the study was that the data did not identify the effects on nursing practice (Lee, 2006). A recommendation for future research is to monitor changes in documentation patterns based on patient care assessments and monitor the quality of documentation measurements. A longitudinal study that incorporates nurses experiences and knowledge would be beneficial. Further understanding of discrete information capture versus narrative charting is necessary to better understand potential lost information (Lee, 2006).

A recent question raised with EHR adoption, is does the device nurses use to document impact the diffusion of innovation? The personal digital assistants (PDAs) increased in sales to 13.1 million devices worldwide because of their multi-functionality. PDAs have the potential to save time, prevent errors, and increased mobility of the device is hypothesized to reduce potential harm events, however the challenge for nurses to have accurate, reliable information at the point of care is a significant concern (Di Pietro et al., 2007).

Di Pietro et al. (2007) investigated what nurses want and require as clinical decision support at the point of care using the Rogers DOI theory, along with how PDA technology impacts adoption of computerized documentation. A cross-sectional design was used to determine the needs at the point of care for the clinical-decision making process. Direct care nurses were selected from four units in two acute care hospitals and
two home care settings. Nurses completed over 50 patient care assessments and the results were summarized in the following four categories: hardware, software ease of use, software content, and network. The amount of documentation to capture data electronically was reported to be a challenge. The results indicated DOI proved to be relevant by the perceived attributes of the innovation; this accounted for 40 to 90% of the variance of the speed of adoption. Observed sampling indicated a significant portion of nursing documentation was captured using another mode other than the PDA or electronic device and then later transcribed in the patient record. The goal of the study was to investigate if an alternative device would impact adoption of computerized documentation for nurses but the study design was fragmented and it was difficult to evaluate if the PDA tool would impact improvements in safety and quality of care. Future studies are recommended to evaluate if connecting the innovation to the user through tools that are specific to the nurse workflow will improve care delivery (Di Pietro et al., 2007).

For over two decades organizations have sought to develop and implement strategies to provide systematic, efficient care processes. The EHR has been the primary mode of innovation. In modern nursing, clinical leaders have attempted to leverage the computerized system to improve nursing care delivery. Von and Naden (2008) investigated the Nursing Intervention Classification and Nursing Outcome Classification (NANDA) tool and the issues of integration into nursing services and documentation. The NANDA tool has been designed for EHRs and has been implemented in various hospital settings. Five test sites were selected to explore the implementation process of NANDA. The purpose of the study was to use DOI’s claims that innovations are
promoted through social support, and integrate innovation adoption with direct patient care experiences. The test site implementation method was a two phased approach with five clinical sites. One phase was to identify the teaching requirements for the staff, develop objectives around implementation needs, formulate measures, and develop reference material to enhance implementation learning. The second phase included the provision of multiple ways for the staff to implement the learning, and the opportunity to provide their feedback on a regular basis. The results indicated low rates of adoption in the first year of innovation implementation. The second year, all five sites adopted computerized documentation with assessment notes, and two of the five sites adopted care planning modalities in addition to the assessment notes. The highest percentage of adoption was evident at those clinical sites with an interdisciplinary background. The strength of the study was the use of DOI framework to investigate factors that impact adoption during the implementation of a new nursing documentation tool. Variables such as implementation methods were not well controlled, resulting in a wide range of outcomes. This was a weakness in the study. Recommendations for future research are to replicate the study when introducing a new nurse documentation tool under a controlled environment, and focus on implementation factors that may influence outcomes (Von & Naden, 2008).

The exploration of leading innovations remains the greatest opportunity for our future, however the process of dissemination of innovation requires a great deal of investigation. The creation of a better future requires healthcare leaders to explore the needs of the environment in order to promote adoption (Berwick, 2003).
Nurse Practice Environment

The primary focus for hospitals is the provision of healthcare services, to care for the sick, injured, and people in need. Patient care outcomes are influenced by the staff that cares for them; factors impacting the healthcare practice environment are job satisfaction, turnover, and the ability to work safely and effectively (Rathert, Ishqaidef, & May, 2009). Recently, the high demands in healthcare have resulted in increased vacancy; research is necessary to further understand the healthcare practice environment. Nurse scholars have discussed that high quality care requires the ability for intimate relationships between each patient (Rathert et al., 2009).

Rathert et al. (2009) examined a theoretical model integrating the nurse work environment and how it relates to work engagement, organizational commitment, and patient safety during implementation of computerized documentation. In addition, the study investigated how work environment influences staff psychological safety. The method used was questionnaire packets mailed to eligible participants; the response rate was 42% and the final sample size was 252 nurses. The study analyzed perceptions of staff that provide direct patient care. The sample size was categorized as follows: 87% were nurses; 7% were classified as allied health professionals, and 6% were health care support personnel. The use of structural equation modeling found that different variations of the work environment were related to different outcome variables. A climate for continuous quality improvement was positively related to organizational commitment and patient safety, and psychological safety partially mediated the relationships ($p < .001$). A regression analysis indicated patient centered care was significantly and positively related to commitment ($B = 0.45, z = 2.7$), and negatively related to engagement ($B = -.61, z = $
2.74) and psychological safety ($B = -.67, z = -1.93$). Direct path relationships were found and therefore partial support for the theoretical model was determined (Rathert et al., 2009).

One weakness of the study was that there was only one data site for collection, provided limited variation of interests with work environments. Various measures had low reliability based on testing theory. Future research is recommended to analyze work environments and outcome measures at the organizational level. The research topic would be enhanced with studies that include additional organizational level data investigating dependent variables (Rathert et al., 2009).

There are many factors that impact nurses’ direct practice. According to Eaton-Spiva et al. (2010) the changing demographics of both patients and nurses have the potential to impact the nurse practice environment. Eaton-Spiva et al. (2010), aimed to gather the following information of the nurse practice environment: nurses’ perceived empowerment level, cultures on nurse units, barriers to providing quality care, and the process of monitoring the continuous improvements in the practice environment. The study was a mixed methods design and used two methodologies for data collection. The first was an online survey with three instruments, the Practice Environment Scale of Nursing Work Index (Lake, 2002), the Conditions of Work Effectiveness Questionnaire II [CWEQ-II] (Laschinger, Finegan, Shamian, & Wilk, 2003), and the Nursing Unit Cultural Assessment Tool [NUCAT-3] (Coeling & Simms, 1993). The second data collection method was semi-structured focus group meetings that included two sessions on four nursing units. Construct validity was established by comparing scores of nurses in Magnet versus non Magnet hospitals, and Cronbach alpha coefficients that ranged from
Data from the online survey and focus group meetings were analyzed by a project team. Forty-six nurses completed the online survey; the sample was representative of the hospital’s population of nurses. The results of the survey found the Practice Environment Scale Cronbach alpha coefficients were greater than .87. For the entire sample of nurses, all five subscales and composite score, 2.81 (SD, 0.50), suggested a favorable environment. The CWEQ-II had Cronbach alpha coefficients greater than .83, and demonstrated a moderate level of nurse empowerment (SD, 4.4). The highest scores on the NUCAT-3 indicated behaviors important to nurses. These behaviors included the following themes: valuing technical skills, using professional judgment, following orders and policies. Nurses described supportive leadership, orientation, and interdisciplinary team work as possible beneficial work environment characteristics. Thirty nurses attended focus group meetings from four hospital units. A constant comparative analysis was used and the data was summarized in the following categorical issues: system and process, interactive, clinical, and departmental. Examples of system or process issues were related to documentation. Charting was described as redundant, irrelevant, and in too many forms. An interactive issue was described by nurses as broken nurse physician communication patterns. Nurses described clinical issues as effective or ineffective staffing patterns. Departmental issues were described by nurses as those behaviors that improved efficiency including interdepartmental processes such as supply distribution. Finally, nurses discussed elements that contribute to positive working environments. These were supportive leadership and strong teamwork (Rathert et al., 2009).

The strength of the study was the mixed method design. The design provided large amounts of information on barriers that prevent nurses from providing care; the
focus groups provided additional data that could not be gathered from the survey tools. The study was actionable, providing a structure for units to formulate specific action plans to improve their work environments (Rathert et al., 2009). A limitation of the study is that the research is difficult to replicate without a large team of researchers.

A favorable practice setting can improve nurse satisfaction and minimize the risk of turnover. The implications for improving nurse retention in hospitals are improvements in care delivery. Smith, Hood, Waldman, and Smith (2005) investigated whether there were direct effects on job satisfaction if nurses’ professional practice expectations were met. A quantitative study design using descriptive statistics analyzed a sample size of 61 nurses. Practice environment variables were measured on a five point Likert scale of 1 to 5, representing choices ranging from very poor and to very good. There were three job characteristics related to the nurse practice environment measured, job creativity, job empowerment, and fair performance evaluations. Nurses responded they were fairly satisfied with overall job characteristics (mean = 3.76). A mean of 3.37 for organizational commitment indicates respondents were neutral in their commitment to the organization. Analysis of variance was used to ascertain differences in the variables. The results indicated nurses who feel the practice environment met their expectations are more likely to report higher job satisfaction ($p < .01$), management style ($p < .05$) and quality of service orientation ($p < .05$). Random selection of participants and the controlled design were study strengths. Limitations of the study were that the authors did not disclose barriers, or potential biases (Smith, Hood, et al., 2005).

The historical restructuring of healthcare work environments has potentially compromised the provision of nursing care and patient safety. Laschinger and Leiter
(2006) conducted a quantitative study to test how professional nurse work environments impact patient safety outcomes. The sample size consisted of a subset from a larger international study: the International Survey of Hospital Staffing and Organization of Patient Outcomes, conducted in five countries. Over 17,000 nurses returned questionnaires and they were analyzed through the NWI-R and NWI-PES scales, in addition the Maslach Burnout Inventory-Human Service Scale (MBI-HSS) (Leiter & Schaufeli, 1996) was used. The results were analyzed through Cronbach alpha reliability estimates and correlations for variables indicated emotional exhaustion and depersonalization were highly correlated ($r = 0.71$), and both are moderately correlated with personal accomplishments ($r = -.28$ and $r = -.35$). The strongest correlations with adverse events were with staffing patterns ($r = -.30$). The most frequent patient safety events were patient complaints followed by nosocomial infections, patient falls, and medication errors. The majority of structural coefficients were statistically significant. Longitudinal studies were recommended for future research and replication of the existing sample to validate the study’s findings (Laschinger & Leiter, 2006).

The potential workforce shortage in the profession of nursing has a significant impact on healthcare costs. A direct relationship exists between job satisfaction, retention, turnover, and the nurse practice environment. Kotzer and Arellana (2008) aimed to describe and compare staff nurse’s perceptions of their actual and perceived ideal work environment. A quantitative, descriptive survey design with a convenience sample from five inpatient units was conducted. The work environment scale (WES), (Moos, 1994), was used to measure the nurse’s perception of their practice environment. The survey was distributed to 385 subjects and 157 returned the questionnaire for a 41%
response rate. Spearman’s rho statistic indicated a strong positive correlation between age and total years as an RN ($r = 0.80$, $p < 0.001$). Overall the results indicated staff nurses scored involvement on their unit highest ($M = 7.74$, $SD = 1.6$), and physical comfort the lowest ($M = 3.80$, $SD=2.4$). Nurses were able to identify areas of improvement in their work environment, and significant differences were found between real and ideal expectations amongst the nursing units ($p < 0.05$). Nurses identified positive work environments are those that have high levels of involvement at the unit level and autonomy with task orientation (Kotzer & Arellana, 2008).

The strengths of the study were that it provided measurable data for future evaluations of practice environment aspects for nurses, and provided evidence based information linking nurse practice environment demographics and organizational culture. The study supported the need for future research on nurse practice environments within an organization that provide critical information for improving patient care quality (Kotzer & Arellana, 2008).

Staff nurse practice environments must be improved to increase the quality and safety of acute care hospitals. For over a decade researchers and accreditation organizations have identified the need for improvements in nursing care delivery (Schmalenber & Kramer, 2008).

Schmalenber and Kramer (2008) hypothesized that staff nurses in hospitals designated as having excellent work environments (Magnet) would score significantly higher on The Essential of Magnetism (EOM) (Verran, Gerber, & Milton, 1995) tool. Over 10,000 nurses in 34 hospitals completed the EOMII and the hypothesis was confirmed. ANOVA with post hoc multiple comparisons were used to determine the
differences in nurses who rate their practice environment as excellent and those who do not. Nurses in magnet hospitals scored significantly higher ($p < 0.001$) than nurses in comparison hospitals on all relationships and processes of work environments. Nurses in magnet organizations had significantly higher overall job satisfaction (OJS) (mean 6.86, $SD = 0.4604$) than nurses in comparison hospitals (mean 6.22, $SD = 0.418$). Specifically in the areas of context, nurses in magnet organizations rate their productivity higher; those nurses with higher education rate their practice environment higher; and experience and clinical units were rated higher (Schmalenber & Kramer, 2008).

The strength of the study is its consistency with past research findings, and the results contribute evidence that the EOMII is valid and reliable. However, a weakness to the research is there was no measure applied to the findings that EOMII is a valid instrument (Schmalenber & Kramer, 2008).

Interruptions in nurse workflow can potentially lead to patient harm. Hall et al. (2010) conducted a mixed method study to observe and explore the nature and effects of workflow interruptions of RNs. Observations from 30 randomly selected nurses across six units were completed. Work observations were entered in SPSS and data was categorized independently by two research team members and coded into five categories. Nurse interruptions were categorized as (a) sources of interruptions that take nurses away from a their original intent, (b) types of interruptions, (c) causes of interruptions, (d) interruptions during the provision of nursing care, and (e) the outcome of the interruption. A large number of workflow interruptions were reported; over 1,600 interruptions occurred in nearly 800 observation hours. The majority of interruptions resulted from the healthcare team (physicians, pharmacists, and family members) representing over 50% of
the total interruptions. The interruptions were mainly patient related questions. Twenty percent of nurse interruptions occurred as a result of needed supplies to provide direct care tasks. Types of interruptions were categorized as distractions, discrepancies, and breaks. Statistically significant differences between medical and surgical units existed amongst nurse activity interruptions ($f_{1,685} = 5.602; p = .01$). Nurses were more likely interrupted during patient assessments and documentation tasks on a surgical floor than a medical floor. Overall, the interruptions observed could have a negative impact on patient safety ($n = 1,504, 89.2\%$), whereas few interruptions held the potential to improve patient care ($n = 183, 10.8\%$). Interruptions that contributed to a decline in patient safety were medication delays, environmental activity, and noise that interfered with patients’ sleep (Hall et al., 2010).

The strength of the study was its mixed method design, providing details on specific nurse workflow interruptions and potential for patient harm. The limitation was the small sample size preventing causation. Recommendations for future research indicated additional mixed methods studies were needed to add to existing literature on the effects of the nurse practice environment on patient care outcomes (Hall et al., 2010).

Nurse leaders have the potential to promote safety and workplace stability at the organizational level. Factors in the nurse practice environment, such as staffing models that reduce variation, greater teamwork, and support for job satisfaction, have demonstrated an increase in patient quality outcomes (Bogaert, Clarke, Roelant, Meulemans, & Heyning, 2010). Bogaert et al., (2010) investigated the impact of practice environment factors, such as burnout at the nursing unit level on job outcomes and nurse assessed quality of care in acute care hospitals. Nurse practice environment dimensions
were measured using the Revised Nursing Work Index (Aiken & Patrician, 2000). Burnout dimensions were measured by Maslach Burnout Inventory (Leiter & Schaufeli, 1996) and job outcome along with nurse-assessed quality of care were measured as dependent variables. A sample size of 244 staff nurses across 13 medical surgical and intensive care units were given a survey measuring variables of interest. Results of the study indicated 60% of the sample reported a significant association between nurse practice environment and burnout dimensions. In addition, significant associations were found between job satisfaction, turnover intentions and assessed quality of care as well as bedside nurse practice variations. There were significant correlations (Pearson’s) ($p<0.05$) between studied variables with values ranging from 0.11 to 0.58. The variables included burnout dimensions, 0.06; emotional exhaustion, 0.09; depersonalization, 0.23; and personal accomplishment, 0.12 (Bogaert et al., 2010).

The conclusion of the study was, “nursing unit variation of the nurse practice environment and feelings of burnout predicts job outcome and nurse presorted quality of care variables” (Bogaert et al., 2010, p.1664). The strength of the study was the large sample size, and the study design measured the indications for research. The study limitation identified was that nurses almost unanimously scored staff patterns as too low; a larger sample size was necessary to confirm such an outcome (Bogaert et al., 2010). Further research is recommended to study specific quality outcomes based on the nurse practice environment, such as failure to rescue and nurse sensitive outcomes (Bogaert et al., 2010).
Nurse Decision Making

The healthcare environment is complex and researchers are attempting to further understand how the environment impacts nurse decision making. Researchers have reported findings that nurses may have a low to moderate level of autonomy regarding decision making for their practice. Clinical decision making can be defined as the nurse’s participation in their usual clinical practice tasks. Hoffman et al. (2004) investigated factors influencing decisional involvement for RNs. Their study aimed to determine the relationship between occupational orientation (value to the role), nurse’s educational level, experience, area of practice, level of appointment, and age, as these related to participation in decision making for nurses. The researchers received permission to use the Rhodes (1985) questionnaires to measure role values and decision making. Cronbach’s alphas were calculated at > or equal to 0.70 to confirm validity and reliability of the instrument. A sample size of 174 nurses were given a survey which resulted in a 58% response rate. Results of the study indicated that education and experience were not significant factors that correlated with decision making for nurses \( r = 0.332, p < 0.05 \).

The most significant factor influencing decisional involvement was value of the role. Spearman correlations were used with two-tailed tests of significance. There was a significant positive relationship between professional orientation and perceived decisions \( r = 0.332, p < 0.05 \). Using simple linear regression, professional values had significant correlations with decisional involvement for nurses \( R^2 \) of 0.10, significant at 0.001. Twenty-four percent of the remaining variables, including professional values, level of appointment, age, and area of practice with perceived decisions, demonstrated significance <0.001 (Hoffman et al., 2004).
The strength of the research was the enhancement to existing knowledge and research, in that the value of the role was an unexpected finding. The limitations to the study were that weak correlations were found in some variables due to small sample size for the statistics used, and generalizability was affected given the limited sample size location (Hoffman et al., 2004). The confidence intervals may be falsely narrowed. Further qualitative research studies were recommended to further explore value of the role and how it relates to decisional involvement for nurses and the quality of patient care (Hoffman et al., 2004).

As a result of ongoing practice changes for nurses due to the influx of innovations in direct care practice, the study of decision making characteristics are a challenge to formulate. Across the globe nurses are being criticized for poor quality of care and further research is necessary to understand the lived experiences of nurses. Hagbaghery et al. (2004) conducted a qualitative, grounded theory study of a 38 participant sample using semi-structured interviews to explore aspects of clinical decision making for nurses. Five themes emerged from the study: feeling competent, being self-confident, organizational structure, nursing education, and being supported. All were considered important factors in effective clinical decision-making. The data supported the existence of an interactive relationship between the above variables. In addition, organizational structures, management styles, and nurse education level are contributing or inhibiting factors. The strength of this study is the confirmation of existing research and a more in depth understanding of the factors influencing clinical decision making for nurses. Recommendations for future research are replication of the study with other populations of nurses, documentation and investigation of nurse practice patterns, and interaction of
the organizational structure management style and nurses self confidence in clinical decision making (Hagbaghery et al, 2004).

Nurse autonomy to participate in decision making can be significantly impacted by leadership styles. Mrayyan (2004), examined nurse autonomy related to patient care decisions. The ability for nurses to manipulate the patient care environment to provide safe care when changes in patient’s condition arise is necessary to stabilize care in today’s hospitals. There is a return on investment with promotion of nurse participation in decision making for nurse managers. Mrayyan (2004) states, “the presence of autonomous and long-serving nurses would have a positive effect on the quality and cost-effectiveness of patient care” (p. 336). The comparative descriptive study found nurses were more likely to participate in decision making regarding patient care decisions versus operational decision making. Data was collected from 317 hospital nurses who participated in a four part autonomy assessment scale. Surveys returned were analyzed by Pearson product moment correlations, regression analyses, and content analysis for two open-ended questions. Comparisons between U.S. and non U.S. hospitals included differences in the nurses from the U.S. who worked straight shifts as opposed to non U.S. nurses who had more rotating work shifts ($p < 0.001$), in addition there were significant differences in U.S. nurse education at the baccalaureate or master’s level ($p < 0.001$). Nurse’s perceived patient care related decisions, defining the provision of tasks required, with greater autonomy at 3.74 out of a 5 point Likert scale, while decisions related to unit operations, organizing workflow and resource allocation, were scored at 2.56. The study found supportive management ($n = 52, 16.4\%$), education ($n = 20, 6.3\%$), and experience ($n = 21, 6.6\%$), were the three variables that staff reported increased their autonomy. The
three most significant factors that hindered nurse autonomy were autocratic management (n = 67, 21.1%), poor physician communication (n = 28, 8.8%), and workload (n = 14, 4.4%) (Mrayyan, 2004).

The study measured its purpose to examine perceptions of hospital based nurses decisional making. The limitations to the study were the web-based reported tool; a low response rate, and the majority of nurses responded while working which could contribute to low perception of autonomy. Recommendations for future research are to utilize this study as a baseline for intervention studies on perceived autonomy over nursing care decisions (Mrayyan, 2004).

The profession of nursing is responsible for the constant surveillance of patients’ conditions. As a result, the need for efficient operations in healthcare organizations has resulted in advocating for nurse participation in decision making related to patient care, working conditions, and the organizational policy. Jaafarpour and Khani (2011) conducted a quantitative study to investigate how the actual and preferred levels of decision making for RNs have been associated with positive patient outcomes. In a descriptive study using the decisional involvement scale (DIS)( Lake, 2002) with 21 items measured the actual and preferred decisional involvement of the direct care nurses and managers on a unit. The results indicated unit governance and supportive leadership were the most preferred forms of decisional involvement (mean = 4.2, SD = .56), while collaboration activities were the most frequently used by nurses (mean = 3.1, SD = .69). The nurses perceived their actual decisional involvement as somewhat or partial (mean = 2.0, SD = .75). According DIS norms unit governance was the most preferred form of involvement (mean = 4.2, SD = .56). A potential limitation to the study was the small
Research has found highly engaged employees is a rarity. Rivera, Fitzpatrick, and Boyle, (2011) investigated the relationship between nurses perceptions of drivers of engagement and actual nurse engagement. The Nurse Engagement Survey (NES) from the Nurse Executive Committee Advisory Board tool was used to measure the drivers of engagement scale. The survey was sent to over 1,000 eligible participants and 510 nurses returned the survey for a response rate of 51%. Results of the study were analyzed using Pearson’s product-moment correlation coefficients and indicated there was a significant difference in the amount of retention in nursing and the level of engagement ($x^2 = 20.54$, $p = .001$). There was also a significant difference in nurse engagement by shift; day shift nurses were statistically significantly more engaged than were off shift nurses ($x^2 = 6.20$, $P = .045$). There were no significant findings in engagement of nurses related to education, gender, or length of time at the research site (Rivera et al., 2011).

The strength of the study was that the instrument had strong validity. Major limitations of the study were the use of self-reported data, and only one organization was represented. The recommendation for future research was to study how institutions can promote nurses to have control over the practice environment, and focus on professional growth and development, both of which have the potential to attract and retain nurses successfully (Rivera et al., 2011).

**Computerized Documentation and Quality Outcomes**

Nurses that have expertise with computer use are more likely to have a favorable attitude towards implementation of an EHR tool. Moody, Slocomb, Berg, and Jackson
(2004) investigated EHR functionality and nurse preferences. A descriptive, cross-sectional research design was used to study a convenience sample of 100 nurses across 23 units. The instrument was developed by the researcher using an evidenced based procedure. Results of the study indicated 36% of nurses perceived EHRs decrease workload; 75% of nurses reported EHRs had improved quality of documentation; and 76% reported EHRs may lead to improvements in quality patient care. The study yielded important information on nurse perceptions, strengths, and barriers with EHR use that included: patient rooms are not conducive to EHR use; duplicate documentation, and interruptions in nurse workflow. Future studies are necessary to study the effects of changes in EHR systems (Moody et al., 2004).

The implementation of an EHR can effect nurses’ time for care delivery. The NANDA care plan tool was introduced to nurses in a teaching hospital and was found to have no effect on efficient care delivery. Smith, Smith, Krugman, and Oman (2005) investigated the impact of online documentation on staff attitudes, completeness of documentation, and the time required for documentation. A quasi-experimental design was used and data was collected pre and post computerization adoption. Nurses’ attitudes towards computer use were assessed using the Nurses’ Attitudes toward Computerization questionnaire. The instrument was found to be reliable with Cronbach’s alpha of .92 and .93 respectively. The use of a Likert-type 1-5 scale, with a total range of 20-100, with a higher score indicating a more positive attitude was utilized to measure the following domains: patient care, benefit to the institution, job threat, legal aspects, and computer use. A convenience sample of 46 nurses was studied in an acute care hospital pre and post computerized documentation implementation. Standard descriptive and comparative
statistics were used. The results of the study indicated a statistically significant difference ($p = .004$) in nurse’s attitudes towards computerized documentation pre and post implementation. There was a decrease in positive attitudes towards documentation. The most significant decrease in scores were: computers make nurse’s job easier ($p<.001$); computers save steps ($p = .002$); increased computer use will provide more time for patient care ($p = .002$), and computer use increases costs by increasing nurse workload ($p = .002$). A chart review of 60 patient records was completed and improvements were found in overall nursing documentation assessments including falls, skin, and patient education. (Smith, Smith, et al., 2005) Further research is recommended to study the effects of EHRs on nurse efficiency and quality documentation.

McLane (2005) investigated experiences and attitudes of nurses’ adoption of EHRs in the practice setting and gathered their perceptions of the value of computer use to support clinical documentation standards. Attitudes of nurses who use an EHR were studied with a 51 fixed-choice Likert-type survey (Gardner and Lundsgaarde, 1994). The survey was sent to 132 nurses and 44 were returned for a 33.3% response rate. Over 27% of staff reported computer use in nurse workflow was repetitive; 70% reported computerized documentation leads to further reporting; 57% reported increased risk to patient confidentiality; and 23% indicated they feared computer use increased workload. Pearson correlations found no significant relationship between previous experience with computers and effects on EHR adoption. The major limitation of the study was the small sample size from the low response rate. The data could be used as a baseline for future studies (McLane, 2005).
The integration of EHRs in nurse workflow has the potential to provide real time patient information for clinical decision making. Dagnone, Wilson, Goldstein, Murdoch, Rimmer, and VanDenKerkhof (2006) investigated patient perception of EHR use during direct patient care activities. A qualitative, semi-structured interview approach was used and 23 participants were recruited following the introduction of PDAs in direct patient care activities. The two major themes that emerged from the study were unobtrusiveness, where participants felt the PDA aided in their perception of quality care, and clinical competence, when all participants felt the PDA enhanced clinical competence. The study contributed strong evidence to suggest technology integration with direct patient care has no negative patient perceptions. The study is limited by the small sample size; further qualitative research on patient perceptions with the use of bedside technology is recommended (Dagnone et al., 2006).

Valid and reliable instruments to study nurses’ views on the use, quality, and user satisfaction with EHRs are needed for future research. Otieno, Toyama, Asonuma, Pak, and Naitoh (2007), developed a survey instrument to measure nurses’ use, quality and satisfaction with EHR systems. Over 1,600 nurses from 42 hospitals were studied with an exploratory factor analysis to determine items associated with nurses’ views on EHRs. All items were measured using the Cronbach’s alpha threshold at greater than or equal to 0.70. Factor analysis revealed three subscales of EHR system use in healthcare. The first scale, nursing care management, had a high reliability (alpha = 0.88) indicating the items had good internal consistency. The second scale, use of order entry, had strong loadings that confirmed construct validity and items had good reliability level (alpha = 0.79). The last subscale, knowledge management, focused on population health and had strong
loadings confirming validity, but the internal consistency level failed to reach the pre-determined threshold of >.70 and the items were removed. Quality of the EHR system including information and service quality both met the threshold (alpha = 0.94 and 0.87 respectively). The user satisfaction scale included the impact of EHR systems on clinical care (alpha = 0.90). A 34-item instrument resulted from the study with use and quality constructs positively correlated with user satisfaction. The strength of the study was the evidence provided to support a valid and reliable instrument to study EHR systems in a direct patient care environment. The study limitation was the limited scope. Utilization of the proposed instrument is recommended for future research (Otieno et al., 2007).

The use of PDAs during direct patient care was studied to evaluate if the tool increased efficiency. Lee (2007) explored patient’s perceptions of how the nurses’ use of PDAs affected patient care. A descriptive, exploratory, qualitative study with in depth one-on-one interviews was used to collect data from 14 patients. Five themes emerged from the study: (a) PDAs increase nurse work efficiency, (b) data accuracy, patient teaching with electronic retrieval of information, (c) ease of use for patients, (d) ease of accessing care givers, and (e) quality of care valued over PDA use. The strength of the study is that the in depth interviews provided insight into patient care experiences regarding direct care technology. Future studies around technology advances and automated functional outcomes were recommended (Lee, 2007).

Keyhani, Hebert, Ross, Federman, Zhu, and Siu (2008), examined the association of EHR components and quality outcomes data from the 2005 National Ambulatory Medical Care Survey. A cross-sectional analysis using combined data from 2004-2005 on 25,564 primary care visits was collected. Separate logistic regressions were used to
estimate the effect of the EHR tools on blood pressure control and the odds of receiving appropriate care. Multivariate models found no relationship between blood pressure control and the presence of computerized physician notes (OR, 1.15; 95% CI, 0.82-1.60). There was, however, a 54% increase in blood pressure control with the presence of an electronic alert to the provider (OR, 1.54; 95% CI, 1.03-2.29). There were no significant improvements in the quality of chronic care delivery with the exception of receiving steroid therapy for COPD (OR, 2.86; 95% CI, 1.12-7.32). The study had several limitations; the statistical analysis did not have a low enough threshold for significance. Also, the large data set used was cross sectional and therefore may not have determined improvements in quality of care. Future research using a longitudinal study should focus on the impact of integrated EHR adoption on the clinical workflows and quality of care (Keyhani et al., 2008).

The use of standardized care plans has been found to increase nurse satisfaction with computerized technology. Dahm and Wadensten (2008) conducted a quantitative, descriptive study to investigate nurses’ perceptions with standardized care plans in an EHR. Nurses’ opinions on the use of standardized care plans and the quality of care delivered were gathered using a web-based, questionnaire survey developed by the first author. A convenience sample was used from one organization with seven nursing units. The survey was sent to 105 nurses and 86 were returned. The study was analyzed using a system for web-based surveys and descriptive statistics. The results of the study indicated 48% of nurses stated standardized care plans should be multidisciplinary. More than 50% of the nurses did not know the standardized care plans were aligned with quality standards; 19% reported they always evaluate the goals of the care plan; and 18% of
nurses reported they use individualized care plans. Forty-six percent of nurses reported they use standardized care plans effectively. The study concluded that nurses’ perceptions of standardized care plans can improve overall quality of patient care, but nurses did not report appropriate utilization of the tool. The strength of the study was the high return rate of the survey at 80.9%. A major limitation to the study was the survey tool was not demonstrated to be reliable and valid. Additional research is necessary regarding the procedure employed by nurses when using standardized EHR care plan tools (Dahm & Wadensten, 2008).

Is seamless integration of clinical information possible? Smith, Banner, Lozano, Olney, and Friedman (2009) investigated the impact of automated vital sign capture using a PDA. A quantitative study with a 20-bed cardiac unit introduced the automated vital sign upload system to evaluate the efficiency and quality of documentation. A total of 1,514 vital sign measurements were captured. Following data examination, 60 documentation errors occurred, a rate of 0.66%. The baseline rate, 4.4%, was established by the researcher prior to the introduction of the new technology. An $\chi^2$ test for independence was used to compare pre and post vital sign automation and found to be statistically significant in the reduction in errors with the use of the system. The results of the study demonstrated significant ($p < .001$) reduction in vital sign documentation error rates with the use of PDA automated capture. The major limitation to the study was data was captured on only one unit; the assumption that patient care was improved could not be made. Further research was recommended to study the effects of data integration on the quality of patient care (Smith et al., 2009).
Computerized technology has the potential to increase the overall costs of healthcare support structures. Himmelstein, Wright, and Woolhandler (2009) studied data from 4,000 hospitals from 2003 to 2008. The study’s purpose was to investigate if EHRs lowered hospital administrative costs and increased the quality of patient care. Pearson, bivariate correlations were used to calculate the overall computerization score and three sub scores, the use of computerized order entry, lower administrative costs, and improved quality of care among hospitals’ EHR adoption. The results using a bivariate analysis indicated that computerized hospitals had higher total costs ($r = 0.06, p = .001$), however when a multivariate analysis was used costs did not increase ($p = .69$). Hospitals that increased their overall computerization at a faster rate had higher costs ($p = .0001$). Hospitals with a higher rate of computerized adoption had a weak correlation to improved quality of care ($r = 0.07, p = .003$). The strength of the study was the large data set; the findings were weak in correlating if widespread EHR adoption will improve hospital efficiencies and quality outcomes. Additional research was recommended (Himmelstein et al., 2009).

Device selection is critical to successful implementation of an EHR. Carlson et al. (2010) investigated devices that would promote adoption of an EHR within nurse workflow. The mixed methods study was designed in two parts, a systematic comparison of timeliness with clinical data entry between stationary devices and mobile devices on six medical surgical units, followed by a series of focus group meetings. Results of the study indicated confidence intervals between stationary devices were significant ($p < .05$), and stationary devices were used statistically significantly more than mobile devices ($\chi^2 = 1488, df = 4, p < .001$). The differences were consistent among all six nursing units.
The focus groups provided additional data on reasons stationary devices were used over mobile devices. Nurses found that mobile devices were heavy, difficult to use, and they broke down or “paused” frequently. The major limitation to the study was the inability to quantify the amount of information unable to be captured in the EHR; in addition, time delays were unable to be studied. Future research on device preference for nurses is necessary (Carlson et al., 2010).

Duffy, Kharasch, and Du (2010) investigated if the use of concurrent computerized documentation during direct patient care by nurses impacts patient perceptions. A quantitative study was conducted with a sample size of 24 nurses who were divided into two groups. One group of nurses was instructed to use the EHR at the point of care, and the second group used paper documentation designed for use for EHR downtime. Results of the study were measured using Wilcoxon 2 sample test and indicated a significant difference in time spent with the patient when nurses used the EHR compared to paper ($p = .001$). There was no statistically significant time difference in communications between the EHR and paper group ($p = .0613$). The study demonstrated marginally significant benefit from nurses using an EHR at the point of care when assessing patients. The strength of the study was the controlled design. The limitation was the small sample size; a recommendation called for replicating the research with more experienced EHR nurses and a larger sample size (Duffy et al., 2010).

EHRs have the potential to transform quality measurements and quality improvement (QI) processes. Continuous quality improvements and patient care outcome measures are the framework for “meaningful use” of EHRs (Persell et al., 2011). Persell et al. (2011), investigated how the implementation of multifaceted QI interventions using
EHR tools, such as point of care alerts, provide more value to specific patient populations (chronic diseases). A quantitative study design using a time series analysis was conducted at a large internal medicine practice experienced with EHR tools. A 25-point time series tool was used to measure the variables (Fisher Exact Test). Results of the study indicated EHR use significantly improved provider performance on fourteen measures ($p = 0.001$ for 8 measures, $p = .02$ for 1), and four other measures improved but not at statistically significant rates from EHR implementation (Persell et al., 2011).

Implementation of multifaceted EHR tools improved compliance with intended care standards. The strengths of the study were strong, valid, with reliable results, and useful tools to increase the use of QI for intended target ranges for organizations to achieve federal standards of documentation (Persell et al., 2011). The multifaceted study made it difficult to individually evaluate which components were responsible for improvements. This was a limitation of the study. Additionally, the study was limited to one group practice and EHR results could not be transferred. A recommendation for further research was exploration of how alerts can improve patient care outcomes in a different setting (Persell et al., 2011).

The Health Information Technology for Economic and Clinical Health (HITECH) Act passed standards to measure quality patient care delivery, known as “Meaningful Use,” and have promoted the expectation to implement integrated EHRs to achieve the required performance level (Elnahal, Joynt, Bristol, & Jha, 2011). Elnahal et al. (2011) investigated how to determine if patterns of EHR adoption on Meaningful Use vary between hospitals with low, medium, or high quality outcomes. The quantitative study utilized data from the Hospital Quality Alliance program to designate the ranking of
hospitals, and a logistic regression model determined the rate of EHR adoption standards. Significant results of the study indicated hospitals ranked as high quality were found to have clinical decision support functions such as an EHR, and electronic nursing notes, \((p = .04)\) and medication lists \((p < .01)\) as compared to intermediate or low quality hospitals. The strength of the study is that the large data set was the first to analyze Meaningful Use standards adoption compared to low, medium, and high quality hospitals. A limitation to the study was the low response rate at 69%. The low response rate was likely do to the exclusion of critically important hospitals from the data set. Also, the techniques to minimize response bias were imperfect. The study was unable to account for various functionalities between hospitals that could contribute to overall performance. Future research in the area of functional interventions to promote EHR adoption and quality outcomes were recommended (Elnahal et al., 2011).

The evidence related to the impact of EHR adoption and quality patient care varies. Only 12% of U.S. hospitals report basic EHR adoption, and little is known on how adoption has affected patient care. Nurses are the primary recipients and users of EHR data. Kutney-Lee and Kelly (2011) investigated the effect of a basic EHR implementation on the nurse-assessed quality of care, including patient safety. A quantitative design using the Multi-State Nursing Care and Patient Safety (MSNCPS) survey tool was mailed to nurses across four states randomly. A sample of over 98,000 nurses completed the survey achieving a 35% response rate, measuring basic EHR adoption functions, nurse staffing, nurse assessed quality and safety outcomes, and hospital characteristics. Results of the study indicated only seven percent of the hospitals had an EHR. Of the hospitals with a fully integrated her, nurses reported hospital administration did not highly prioritize
patient safety, compared to nurses without an EHR ($p < .001$). Logistic regression models were used to evaluate the relationship between EHR adoption on quality outcomes. Nurses who use an EHR reported information was less likely to be absent from the record ($p = .05$), there was a decrease in the likelihood of their unit providing poor quality care ($p < .05$), and a decrease in the odds their patients were not safe for discharge ($p < .05$). Ultimately, the study indicated nurses in hospitals using an EHR were less likely to report adverse outcomes than nurses who did not use an EHR. Nurses using an EHR reported fewer medication errors and better patient care delivery. The strength of the study was the design of comparing and contrasting nurse quality outcomes of those that utilized an EHR versus organizations that do not utilize an EHR. The major limitation of the study was compromised reliability due to the small number of participating hospitals with fully implemented EHRs. The recommendation for future research was to study the quality outcomes of nurses who use a fully integrated EHR, and also study the support structures of nurse leaders (Kutney-Lee & Kelly, 2011).

Furukawa, Raghu, and Shao (2011) investigated the effects of new EHR implementations on nurse staffing patterns and quality outcomes. A longitudinal, quantitative study was designed to address three objectives regarding the EHR implementation and efficiency with nurse staffing. Data was gathered from the national nurse data base (NDNQI) of approximately 1000 hospitals from 2004 to 2008. The results showed nurse staffing increased by 8% from 2004 to 2008. Registered Professional Nurse (RN) hours increased by 13.8%. Licensed Practice Nurse (LPN) hours decreased by 40.3%. Nurse sensitive outcomes improved significantly, hospital patient fall rates declined by 7.9%, injuries related to falls declined by 13.1%, and hospital
associated patient pressure ulcers decreased by 30%. The strength of the study was the large data set used; the limitation was that the study did not address related important issues such as the impact of EHRs on nurse workload, satisfaction, or turnover rates. In addition, the study could not account for other initiatives to improve quality and reduce hospital associated conditions. Recommendations for future research were to conduct an observation study to evaluate nurse workflows related to EHR adoption, and to consider replication of the study investigating staffing and nurse quality outcomes three years or longer after EHR adoption (Furukawa et al., 2011).

Documentation of the ongoing care and patient response to healthcare interventions is fundamental and a significant skill used by nurses to communicate critical patient information to the healthcare team. For nurses, EHR implementation and usage is critically important, as they are the profession that utilizes the information on an ongoing basis. Knowledge gained on nurse workflow is critical for understanding the evolution of innovation adoption (Kelley, Brandon, & Docherty, 2011).

Cornell, Herrin-Griffith, et al. (2010), used a quantitative design to investigate nurse workflows and computer use through direct observations. Four objectives for the study were identified; the first objective was to measure the amount of time nurses spend on the computer and other activities. The second objective was to capture preliminary information regarding nurse activities prior to computerized innovation adoption. The third objective was to record the workflow activities of nurses, and the final objective was to evaluate if workflow activities integrate into the model of nurse care delivery.

The study design included direct observations on two medical-surgical units in an acute care, general hospital setting. A 29 activity list was formulated based on prior
research and institutional knowledge. Researchers were provided digital assistant devices to record the onset, duration, and sequence of all nurses’ activities. Twenty-seven nurses were observed during three to four hour blocks of time for a total of 98.2 hours of observations that were recorded over a four week period, and 8,621 events were captured. The results of the study included: activity assessment/treatment accounted for the majority of time at 18.5% or 98.2 hours, followed by the four communication activities that totaled 12% of the time. Personal time, electronic charting, and walking accounted for 11.4%, 10.1%, and 8.1% respectively. Forty percent of activities lasted less than 10 seconds in duration, “Timelines revealed that nurses constantly switch activities and location in a seemingly random pattern” (Cornell, Herrin-Griffith et al., 2010, p. 366). Computer time was a combination of the following four activities: electronic charting, electronic information retrieval, navigation, and other computer use; total time was 15.4%.

The overall results of the study indicated nurse workflow is sporadic. The study found the pace of nursing activities can be chaotic and random as evidenced by switching from activity to activity. Critical decision making of complex patient care needs can be severely limited under the current practice environment. The lack of integrated computerized documentation activities into nurse workflow can have significant implications on quality of patient care. The strength of study was the design, the outcomes addressed all the objectives. A recommendation for future research was to examine individual workflows such as medication administration (Cornell, Herrin-Griffith, et al., 2010).
Information on individual nurse workflows is useful to measure nurse performance. Nurse performance can be measured by productivity and efficiencies of care, resource planning and allocation, and patient outcomes (Cornell, Riordan, et al., 2010). Cornell, Riordan, et al. (2010) investigated the impact of EHR upgrades on nurse workflow (frequency and duration of nursing activities). The research design included a series of four observational studies conducted on medical surgical units in two hospitals. Twenty-two nurses were randomly observed for a total of 196 hours in one site and 185 hours at the other site, and were studied pre and post implementation of EHR adoption.

Analysis of variance revealed significant differences in the time spent on nursing activities. The results of the study indicated walking and communication activities were the most frequently observed activities, more than 32% of the total recorded time. Three of the computer activities, electronic charting, electronic information retrieval, and navigation, are among the most frequently observed activities at 19%. In total, all computer related activities increased from 16.7% pre-implementation to 29.1% post-implementation. The strength of the study was the direct observation design; this enabled the researcher to document workflow characteristics in real time. The limitation of the study was the large activity set; only half of the 29 activities were observed 2% of the time. The recommendation for future research was to replicate an observational study with a smaller activity set with organizational outcomes investigated (Cornell, Riordan, et al., 2010).

**Methodology and Methods**

This literature review included 33 articles; 26 quantitative studies, five qualitative studies, and two mixed method research designs. Four studies focused on the diffusion of
innovation, eight studies provided factors related to the nurse practice environment, three studies focused on nurse decision making, and 18 studies focused on the impact of EHRs on nurse workflow and quality outcomes. Studies on innovation adoption in healthcare were included as context to provide a framework for organizational adoption of new technology such as EHRs. Contextual information regarding nurse practice environments and nurse decision making was provided for the purpose of exhibiting information on nursing practice and the nature of complex decision making.

The literature demonstrates a wide range of research tools. Activity assessment tools have been found useful in measuring the impact of change on nurse workflow. Researchers interested in macro level issues, such as direct versus indirect care activities use less assessment categories (Cornell, Riordan, et al., 2010). Extent and quality of use with EHRs can be studied using a 34-item instrument that has demonstrated a positive correlation with user satisfaction (Otieno et al., 2007). Large data sets, such as NDNQI, are useful in the evaluation of nurse sensitive outcomes, including productivity levels post EHR implementation (Furukawa et al., 2011). “As more advanced EHR systems diffuse into practice, managers and policy makers should consider potential negative associations of EHR implementation on patient safety” (Furukawa et al., 2011, p. 311).

The use of qualitative research or mixed method designs are recommended to further expand understanding on specific EHR nurse adoption workflows. In depth understanding of nurses’ perceptions toward EHRs may provide organizational leaders information to improve strategies for adoption and integration in clinical workflows (Moody et al., 2004). Accurate clinical information is essential to sustain and improve
patient care quality outcomes; nurses are the greatest users of EHRs and should have a significant support for adoption (Nelson & Massey, 2010).

**Research Gaps and Recommendations**

Understanding the impact of innovation adoption such as EHR implementation and effects on the nurse practice environments, decision making, and quality outcomes is a challenge. Considerations for future research are recommended and necessary to explore, confirm, or add to the vast amount of existing literature. Recommendations for future studies include EHR workflow integration, effects on quality and productivity, patient and nurse satisfaction, and device selection both at the organizational and direct care level (Cornell, Herrin-Griffith, et al., 2010). In the research presented, nearly every study recommended future research or recommendations to replicate existing studies. The majority of research did not provide data on individual variables, and a major gap in the literature exists with organizational support structures and/or leadership attributes that would improve EHR adoption.

**Chapter Summary**

The literature review includes a total of 34 studies related to innovation adoption, the nurse practice environment and decision making with EHR adoption and the effects on quality outcomes. The literature on Electronic Health Records is vast and many studies were excluded from this paper because they lacked information on nurse specific information, emphasized the medical profession alone, or lacked information on the quality outcomes post implementation.

The literature review revealed that nurse adoption and integration of an EHR into direct clinical practice can affect patient quality and safety outcomes, nurse satisfaction,
and patient satisfaction. Gaps in the literature were found regarding how nurses adopt EHRs into their direct care practice, the study of independent variables that may enhance or prevent adoption, and organizational support structures that would promote adoption and complex clinical decision making.
Chapter 3: Research Design Methodology

Introduction

The primary focus for hospitals is the provision of healthcare services, to care for the sick, injured, and people in need. Patient care outcomes are influenced by the nursing workforce; factors impacting the nurse practice environment include job satisfaction, turnover, and the ability to work safely and effectively (Rathert et al., 2009). Recently, the high demands in healthcare institutions have challenged nursing practice. A favorable practice setting can improve nurse retention and quality patient care. The implications for improving nurse retention in hospitals are improvements in care delivery or the nurse practice environment (Smith, Hood, et al., 2005). The healthcare environment is complex and researchers are attempting to further understand how the environment impacts nurse decision making. Researchers have reported findings that nurses may have a low to moderate level of autonomy regarding decision making for their practice. Studies have found that there are many factors that impact nurses’ ability to participate in decision making. The vast amount of research has provided important information for healthcare leaders to improve patient care delivery processes, with the potential to improve quality of care.

The topic of interest for study is the requirement and adoption of a comprehensive EHR in healthcare institutions. Even though computerized documentation has been introduced in the healthcare environment for decades, factors that influence direct care
clinician adoption are vague. Computerized documentation has the potential to enhance the quality and safety of care delivery if the diffusion of innovations is secured. Future research is needed to explore successful integration of an EHR using the diffusion of innovations model (Von & Naden, 2008). Clinical outcomes demonstrated improvements or comparative progress following the dissemination of innovations by a staged approach (Schrijvers, Oudendijk, & Vries, 2003). The diffusion of innovations model provides valuable insights into the reasons innovations are adopted in direct care clinical practice while others fail.

The use of computers to collect patient care data represents an innovative change in nursing practice. The workflow of direct care nursing practice is complicated, and adoption of computerized documentation presents challenges that require further insight from nurses (Lee, 2004). DOI theory has been utilized throughout a variety of research studies, and is applicable to the topic of interest. Innovations, such as computerized documentation, are adopted when individuals recognize the change is applicable, easily incorporated into practice, can be tested and changed, and clinicians are visualized using the innovations (Swanson-Fisher, 2004). DOI provides a viable theoretical framework to further research the effects of a fully integrated EHR adoption on the quality of nursing care.

**General Perspective**

The purpose of the research is to measure the impact of EHR innovation adoption on the quality of nursing care delivered. Adoption of EHR innovations can increase the time a nurse has to provide direct patient care, subsequently improving the quality of patient care delivery. The research design was a quantitative, descriptive study that
establishes associations or relationships between variables. The study methodology identified the effects on the following quality nursing care outcome variables of care delivered: (a) hospital acquired patient falls; (b) hospital acquired pressure ulcers; (c) nurse turnover and nurse satisfaction; (d) worked nursing care hours (measured in overtime and hours per patient day) with the implementation of EHR tools, as measured prior to adoption, at the time of adoption, and following the first year of adoption in the nurse practice environment. This research used existing, retrospective data from a large acute care hospital system. Prior to initiating any of the following procedures, approval from the Institutional Review Board (IRB) at St. John Fisher College was obtained. The researcher also obtained approval from the IRB at the healthcare facility.

**Problem Statement**

The evaluation of the nurse practice environment given the introduction of technology is useful information in assessing performance, efficiency of care, and resource planning and allocation (Cornell, Riordan, et al., 2010). Nurse workflow and the quality of nursing care delivery may improve with the adoption of a comprehensive EHR. System adoption is critically important to increase the ease and accessibility of information to provide time for nurses to analyze, synthesize, decide, and deliver patient care (Cornell, Riordan, et al., 2010).

The use of an EHR has the potential to improve the overall quality and cost management of patients in the hospital setting. The hypothesis of the study is that nursing quality, costs, and satisfaction improve over time once the innovation adoption is integrated into the nurse workflow. A quantitative, descriptive study, using an Interrupted Time Series (ITS) model to analyze retrospective data at the point of nursing care one
year prior to EHR adoption, from the time of initial implementation, and one year post implementation of EHR tools. A retrospective study is research that uses information from the past to draw conclusions. Regression modeling postulates relationships between continuous dependent variables and an independent variable (Vogt & Johnson, 2011). The data analyzed the following research questions:

- What are the behavior changes in nurse workflow during the early adoption of innovation on medical/surgical and critical care units?
- Does EHR adoption in nursing practice with adult medical surgical and critical care patients improve quality of nursing care, nurse satisfaction, nurse retention, and costs of care?

**Research Context**

The setting for this research study was conducted in a large community hospital system located within a large urban city in New York State. The central New York hospital provides comprehensive healthcare services and was founded by the Sisters of St. Francis over 145 years ago. The organization is faith based and allocates resources to ensure both the physical and spiritual health of the community seeking care is addressed. The organization has over 4,000 employees, 800 are physicians, and 1,737 are nurses. The organization employs 1,437 registered professional nurses (RN) and 300 licensed practical nurses (LPN). Thirty-eight percent of the direct care RNs are bachelors prepared and 50% of qualified nurses are certified within their specialty. The hospital is licensed for 431 acute care beds, 339 of which are designated to provide medical surgical and critical care services. The hospital serves approximately 27,500 patients’ annually and yearly emergency department (ED) patient visits have exceeded 70,000.
Upon planning for the study, it was initially decided to use data from multiple healthcare organizations. After further consideration and advisement, it was determined that the study would be strengthened by collecting longitudinal data from one institution to trend over time. After concluding that the majority of healthcare institutions throughout New York State collect similar nursing quality outcomes data, the researcher determined this methodology would add to the existing body of literature.

**Research Participants**

The source of data analyzed is from the National Data Base of Nursing Quality Indicators (NDNQI) from 2010 through 2013, and existing organizational data from the human resource and performance improvement departments. The hospital has reported nursing sensitive indicators and cost outcome measures to the NDNQI database for over 10 years. Nursing sensitive indicators are defined as hospital acquired falls and pressure ulcers. Cost outcome measures are defined as hours per patient day (HPPD), and the utilization of overtime pay practices.

The NDNQI is the only national database that provides quarterly reporting of staffing and outcome measures at the unit level, with over 1,000 organizations represented (Furukawa et al., 2011). The sample data measures events per 1,000 patient days. Additional sources of data include human resource information of nurse turnover from 2010-2013; the total number of nurses by quarter that exited the institution; and 2010 and 2013 annual nurse satisfaction survey outcomes. There were over ten medical surgical units and two critical care unit data sets studied. The researcher called and formally requested approval in writing to the hospital’s administration, and to IRBs to study the administrative data.
Research Instruments

Following the researcher’s receipt of approval from the organization’s Institutional Review Board (IRB), data from the NDNQI and organization’s archived human resource and performance improvement statistics from the years of 2010 through 2013 was obtained (see Appendix A). The data was entered into the research instrument the R statistical package and an Interrupted Time Series (ITS) regression procedure was used to measure how the EHR tool, as the independent variable of study, impacted the dependent variables of quality nursing care delivered. The ITS approach is used to establish relationships as a basis for prediction. The procedure is crucial for clinical decision making and goal setting. In addition, it is critically important for efficiency and quality of patient care, especially in environments where resources are limited (Portney & Watkins, 2000). Implementation of EHR technology tends to vary across institutions, care settings, and time (Himmelstein et al., 2009). Information on individual nurse workflows is useful to measure nurse performance. Nurse performance can be measured by productivity and efficiencies of care, resource planning and allocation, and patient outcomes (Cornell, Riordan, et al., 2010).

Healthcare services are one of the earliest users of existing data sources for the purposes of studying hospital costs and markets (Waltz, Strickland, & Lenz, 2010). Due to the fundamental problem of using existing data for the purposes of research, the variations in how the data is obtained and collected, this researcher took steps to ensure reliability and validity of the data will be established.

Reliability. Data obtained was compared with measures from other time periods or data from other sources, such as benchmark information that can promote reliability
(Waltz et al., 2010). Results from the NDNQI data set were compared to the national benchmarks for falls, pressure ulcers, productivity, and nurse satisfaction. In addition, comparisons of the benchmarking period to medical record reviews of unanticipated events, such as falls and pressure ulcers, were conducted by both organizations’ risk management departments and were collected for the purpose of this study to secure reliability of the data.

**Validity.** The use of existing data for the purpose of research can challenge validity. Validity using existing data reflects how closely the data corresponds to the researchers anticipated needs of the study (Waltz et al., 2010). While ensuring validity can be a challenge and tends to significantly increase costs of a study, this researcher utilized existing state and national benchmarks to ensure validity by comparing different measures to assess similar attributes.

**Procedures Used**

Both public and private administrative data is often utilized to examine further understanding of hospital based outcomes (Waltz et al., 2010). Data for this study was collected from January 2010 through December 2013 from administrative sources within the healthcare organization, and was handled with strict confidentiality. All data statistics were locked in a hospital assigned location. Hospital names were not used and medical record, human resource, performance improvement, patient and employee specific information will not be kept for any reason following the research analysis. The administrative data and verifying benchmarked information was requested and secured consistent with the hospitals IRB requirements. Data elements were categorized by variable. The independent variable studied, EHR adoption prior to and over the first year
of implementation period, and the impact on nursing practice were organized. Nursing practice is summarized in the following outcome categories: nursing sensitive indicators, costs, and satisfaction measured in nurse turnover rates. All data artifacts collected were stored in a secure area. Data sheets with no individual identifiers were maintained for at least six years before being destroyed.

The target population is nursing medical surgical and critical care specialties. All specialties including but not limited to obstetrics, neonatal, emergency, and surgical services were excluded. The target population included is summarized by demographic variables, including type of EHR tools, patient populations, severity of illness, and length of stay.

**Data Analysis**

Data analysis was conducted using the R Statistical Package 0.2. Interrupted Time Series (ITS) modeling was used to examine the relationship between variables, EHR innovation adoption and the impact on nursing practice. The response variable is measured along with the independent variable sequentially over time. The use of the ITS methodology analyzes data that can explain the association of nursing outcomes over time with the use of EHR technology that are introduced into direct care environment. The construction of time series models analyzes data values over time (Glass, 1997). Various research methods exist for estimating time series; there are descriptive and inferential models. For the purpose of this study, the researcher used an exponential smoothing method. The exponential smooth trending is appropriate when seasonal components of time series are not a factor to be considered. Following the exponential smoothing method, the researcher examined the residuals between the original data and
smoothed data points. Residuals can provide researchers with the general level of variability of data (Glass, 1997). The researcher ensured mitigation of the challenges using existing data was met: (a) the data was appropriate for the research study, (b) the researcher was knowledgeable about the data and potential problems from professional application, and (c) a detailed review of the technical components of institutional data collection methods was completed during the study period (Waltz et al., 2010). The methods used with results of the analysis are presented in Chapter 4.

**Summary**

The intended purpose of this study was to determine if the adoption of EHR tools impacts the quality of nursing practice delivered during and post implementation of the innovation. A large non-profit community based healthcare system was analyzed. Following the receipt of IRB approval, administrative retrospective data was collected. A linear, Interrupted Time Series model design studied the following research questions:

- Are there behavior changes in nurse workflow during the adoption of innovation?
- Does EHR adoption in nursing practice with adult medical surgical and critical care patients improve quality of nursing care?

This study sought to identify the association of innovation adoption and the impact on quality of care prior to and over the first year of implementation of EHR tools in nursing workflow. The impact of changes in the nurse practice environment has been demonstrated in the literature.
Conclusion

Historically, EHRs have been designed to capture clinical tasks during episodes of care throughout the continuum of healthcare services. However, new emerging focus is shifting toward the adoption of an EHR, which has been reported to increase the quality and safety of patient care. The potential benefits of an EHR adoption include: real time patient information, reducing redundant workflow, standardization of care, increased productivity, reduction of errors and more timely accurate communication among all health care providers. The challenges facing healthcare institutions and the profession of nursing are multifaceted. The integration of an EHR has the potential to improve the efficiency of care delivery. As nursing practice increases in complexity, EHR adoption can provide information to improve workflow and support critical thinking and complex decision making (Cornell, Herrin-Griffith, et al., 2010).

Diffusion of Innovation (DOI) theory has been utilized throughout a variety of research studies, and is applicable to the topic of interest. Innovations, such as computerized documentation, are adopted when individuals recognize the change is applicable, easily incorporated into practice, can be tested and changed, and clinicians are visualized using the innovations (Swanson-Fisher, 2004). DOI provides a viable theoretical framework to further research the effects of a fully implemented EHR adoption on the quality of nursing care.

Data was examined from NDNQI and organizational human resource and performance improvement statistics to analyze the diffusion of innovation with nursing EHR tool integration and the effects on quality and costs in the acute care setting. IRB approval was received in October of 2013; data collection began immediately following
the research approval process. The researcher used the R Statistical Package 2.0 edition, and analysis occurred from November 2013 through January 2014. Research validation using chart review and national benchmarks was completed in February 2014. The researcher reviewed data outcomes with a statistician throughout the research process.
Chapter 4: Presentation of Data and Results

Chapter four contains the analysis and results for each research question and related hypotheses. Data analysis was conducted with the R Statistical Package 2.0 using a piecewise regression model. The R package allows a researcher to carry out statistical analyses in an interactive mode. The level of significance was established at \( p = 0.05 \).

Research Question One

The first research question of interest investigated the relationship or impact of Electronic Health Record use on the quality of nursing care delivered. The quality was analyzed using the following outcome indicators: hospital acquired falls, hospital acquired pressure ulcer rates, ventilator associated pneumonia, central line associated blood stream infections, catheter associated urinary tract infections, nurse retention, and costs of care over a pre, during, and post implementation time period of an integrated EHR. The directional hypothesis for this research stated that the implementation of integrated EHR tools improves the quality, safety, and nurse satisfaction over time. The second directional hypothesis for this research was that the implementation of an integrated EHR on nurse workflow impacts quality, safety, and nurse satisfaction during the innovation adoption period followed by improvement from or stabilization to the pre-intervention period. Social change such as technology adoption in nursing practice can be more accurately understood when studied over time. The process of behavioral change is identified distinctively through the diffusion of innovation research (Rogers, 2003). The
focus of this research was to analyze the spread of innovation, or EHR use, over time. Conceptual and analytical outcomes were gained by the study of time as an essential factor in the analysis of human behavior change (Rogers, 2003).

The relationship and impact on nursing quality over time was studied using an interrupted time series model (ITS). A time series method is defined as a sequence of measurements taken at (equally-spaced) ordered points in time. The aim of this ITS research was to analyze the associations between an outcome and one predictor series or intervention. The study utilized estimations, and the model was reduced to a traditional regression framework. Ultimately, the purpose of the research was used to produce an accurate forecast of future measurements given an observed series. The standard statistical approach adopted for the purpose of this research study was auto-regressive moving average (ARIMA) (Center for Statistical Methodology, 2014). The measurements or variables included, were the following hospital acquired conditions: hospital falls, hospital acquired pressure ulcers, Catheter Associated Urinary Tract Infections (CAUTIs), Catheter Associated Blood Stream Infections (CLABSIs), Ventilator Associated Pneumonias (VAPs). In addition to hospital acquired conditions, the cost variables analyzed were nurse productivity measured in hours per patient day (HPPD) and the incidence of over time (OT). The last variable of study was nurse satisfaction measured by nurse turnover rates. The variables researched were collected for a 46 month period between the years of 2010 through 2013. All data points were collected in equal month increments and converted to their publicly defined rate, each data points rate was consistent month over month for the prospective outcome variable. The predictor or intervention of study was the introduction of an integrated EHR in nurse
workflow through nurses' adoption of computerized care plans. For this research site, the adoption of computerized care planning tools completed the final stage of all nurse workflows captured through an electronic based record system. In the 46 month period researched, the intervention occurred just prior to month 22.

The research was conducted using multiple sets of circumstances that are alike in all respects except for the phenomenon that was tested as the possible cause, followed by the observation of the expected effect from the EHR intervention (Glass, 1997). Time series analysis was applied to evaluate the longitudinal effects of the intervention. The main approach relied on a segmented regression analysis involving a pre-post design, where the effect is controlled for a long time trend (Center for Statistical Methodology, 2014). The initial step in time series modeling was to read or enter the data into the R package and plot the time series. Interrupted time series use allows for multiple variables and the intervention relationship to be analyzed over time. Reading the data into R was followed by storing the data into the package. The time series was plotted again for every variable using the simple moving averages to display data in a graphical format.

A regression model was used to measure the slope of the graph pre implementation period as well as post implementation period, followed by a t-Test to compare the two time periods. In addition, trend analysis was used. Although there are no proven techniques to identify trend components in the time series data, the researcher used basic, widely accepted trending tools, as the trending is monotonous (consistently increasing or decreasing). The time series data contained random, or out of pattern data points. Accepted trending tools were used to analyze the identified random points of data that were not consistent with the trending pattern. The two tools used were smoothing
and fitting a function. The smoothing technique estimates the level and slope at the current point in time by averaging of the data locally such that the nonsystematic components of individual observations cancel each other out. The researcher used the most common technique of moving the average which replaced each element of the series by the simple average. Smoothing is controlled by two parameters, alpha, for the estimate of the level at the current time point, and beta for the estimate of the slope (Coghlan, 2013). Fitting a function was used when there was monotonous time series data that could be adequately approximated by a linear function. Using a logarithmic approach when there is a clear monotonous nonlinear component to several data points, the data was first transformed to remove the nonlinearity. This method was appropriate for this research study because the data in the time series was stationary (i.e., its mean, variance, and autocorrelation was constant through time), and there were close to 50 observations in the data. In addition, values of the estimated parameters are constant throughout the time series analysis. The results are displayed in Figures 4.1 through 4.7.

In Figure 4.1 the piecewise regression of hospital acquired falls is provided for the 46 month period of January 2010 to October 2013.
Figure 4.1. Piecewise Regression of Hospital Acquired Falls (incidence per 1,000 patient days) for 46 Month Period (January 2010 – October 2013).

**Figure 4.1 model statistics.** The analysis of falls data revealed a significant model effect, $F(3, 42) = 3.57, p = .02, R^2 = .15$. The piecewise regression coefficients appear in Figure 4.1. Overall, EHR model explained a statistically significant but modest (15%) portion of the variance in falls. Pre-intervention, there is a non-significant relationship between months and falls rate (no relationship between time and fall rate pre-intervention $b = 0.48, p > .05$). Post intervention shows a significant decline in fall rates, for every month fall rates (fall per 1,000 patient days) decrease one half a fall per 10 month period. Thus, for research question one, the null hypothesis is rejected. Consistent with research question one directive hypothesis, post EHR data showed a significant decline in falls.
Figure 4.2 provides piecewise regression of hospital acquired pressure ulcers from January 2010 to October 2013.

Figure 4.2. Piecewise Regression of Hospital Acquired Pressure Ulcers (incidence of ulcer per 1,000 patient days) for 46 Month Period (January 2010 – October 2013).

**Figure 4.2 model statistics.** The analysis of ulcer data revealed no significant model effect, $F(3, 41)=60.99$, $p>.05$, $R^2 = .80$. The piecewise regression coefficients appear in Figure 2. Overall, EHR model explained no statistically significant portion of the variance in ulcers pre or post intervention. Therefore the null was accepted. The data showed that ulcers decreased over the pre intervention period and increased somewhat post EHR, followed by a reduction consistent with the pre intervention period. Post
intervention shows a continual decline in ulcer rates following the increase with the EHR intervention period consistent with hypothesis two.

Figure 4.3 provides the piecewise regression of catheter associated urinary tract infections from January 2010 to October 2013.

![Figure 4.3](image)

**Figure 4.3.** Piecewise Regression of Catheter Associated Urinary Tract Infections (incidence per 1,000 patient days) for 46 Month Period (January 2010 – October 2013).

**Figure 4.3 model statistics.** The analysis of CAUTI data revealed no model effect, $F(2, 42)=12.11, p=7.58, R^2 = .43$. The piecewise regression coefficients appear in Figure 4.3 (with asterisks indicating significance at $p<.05$), thus rejecting the null hypothesis. Overall, EHR model explained a statistically significant difference in CAUTI pre and post intervention. The data showed that CAUTIs decreased dramatically over the
pre intervention period and increased somewhat post EHR, and these coefficients were significantly different, \( t (42) = -3.71, \ p < .01 \). Post intervention shows a sustained reduction significant from the EHR intervention consistent with both directive hypotheses one and two.

*Figure 4.4.* Piecewise Regression of Catheter Associated Blood Stream Infections (incidence of infections per 1,000 patient days) for 46 month period (January 2010 – October 2013).

**Figure 4.4 model statistics.** The analysis of CLABSI data revealed a significant model effect, \( F(2, 42) = 6.52, \ p < .01, \ R^2 = .23 \). The piecewise regression coefficients appear in Figure 4.4 (with asterisks indicating significance at \( p < .05 \)). Overall, EHR model explained a statistically significant portion of the variance in CLABSI. The data
showed that CLABSIs decreased over the pre intervention period and increased somewhat post EHR, followed by a reduction and these coefficients were significantly different, $t(42) = -2.55, p < .01$. Post intervention shows a continual decline in CLABSI rate following the increase with the EHR intervention period, for every month CLABSI rates (infection per 1,000 patient days) decrease less than half an infection per 10 month period, consistent with rejecting the null hypothesis and consistent with the research directional hypothesis one.

Figure 4.5. Piecewise Regression of Hospital Acquired Ventilator Associated Pneumonia (incidence of infection per 1,000 patient days) for 46 Month Period (January 2010 – October 2013).

Figure 4.5 model statistics: The analysis of VAP data revealed no model effect, $F(2, 42)=16.77, p>.05, R^2 = .51$. The piecewise regression coefficients appear in Figure 4.5 (with asterisks indicating significance at $p<.05$). Overall, EHR model explained no
statistically significant portion of the variance in VAP. The data showed that VAPs decreased dramatically ($b=-.24$, $p=.0007$) over the pre intervention period and increased somewhat immediately post EHR, followed by a statistically significant reduction ($b=-.09$, $p=.001$) post EHR intervention period at a statistically significant rate as pre EHR. Consistent with research directional hypothesis two, post EHR data showed a slight increase at the time of intervention followed by a reduction consistent with the pre intervention period.

Figure 4.6. Piecewise Regression of Hours Per Patient Day (total number of nursing staff per discharges) for 46 Month Period (January 2010 – October 2013).

**Figure 4.6 model statistics.** The analysis for HPPD revealed no significant difference between pre and post $F(2,42)=28.36$, $p=.001$, adjusted $R^2=.65$. The overall effect of time on HPPD is not significant ($p>.05$). Therefore the null hypothesis was
accepted, and the data showed the EHR intervention has no significant change following the intervention, consistent with directional hypothesis two.

Figure 4.7 indicates the piecewise regression of overtime usage by total direct care staff for the 46 month period from January 2010 to October 2013.

Figure 4.7 model statistics. The analysis of OT data revealed a significant model effect, $F(2, 42)=3.07, p=.03, R^2 = .12$. The piecewise regression coefficients appear in Figure 4.7 (with asterisks indicating significance at $p<.05$). Pre intervention EHR model explained a statistically significant decrease, and slight increase at the time of the intervention and post intervention period followed by a reduction consistent with pre
intervention period, not statistically significant ($p=.15$). The null hypothesis was rejected. Overall the data showed that OT decreased significantly over the pre intervention period and increased somewhat post EHR prior to returning to baseline, consistent with directional hypothesis one.

**Research Question Two**

The second research question investigated the impact of the integration of EHR tools in direct care nurse workflow on nurse satisfaction over time in one acute care hospital. Nurse satisfaction is directly correlated with job retention in hospitals. Nurses report higher job satisfaction when they feel the practice environment meets their expectations. Nurses’ practice environment is directly and positively correlated with their overall job satisfaction ($p<.01$). This correlation suggests that nurses are less likely to leave their jobs the more satisfied they are with the practice environment (Smith, Hood, et al., 2005).

The data collected and analyzed nurse turnover over a 46 month period. The data was collected and averaged by the total number of nurses that left the medical surgical or intensive care nursing units by 100 to establish the rate. Nurse turnover was collected separately and analyzed for adult medical surgical and intensive (critical) care units. The results of the study’s research on nurse turnover in these units are displayed in Figures 4.8 and 4.9.
Figure 4.8. Piecewise Regression of Nurse Turnover - Medical Surgical (incidence of departure per 100 nurses) for 46 Month Period (January 2010 – October 2013).

**Figure 4.8 model statistics.** The analysis of nurse turnover data for medical surgical nursing units revealed no significant model effect, $F(2, 42)=2.09, p>.05, R^2 = .07$. The piecewise regression coefficients appear in Figure 4.8 (with asterisks indicating significance at $p<.05$). Overall, EHR model explained no statistically significant portion of the variance in nurse turnover. The data showed that nurse turnover was flat over the pre intervention period and decreased somewhat immediately post EHR followed by a statistically significant increase ($b=.08, p=.05$), additionally these coefficients were statistically significantly different, $t(42) = 5.008, p<.01$. Post EHR there was a
statistically significant increase in nurse turnover over time, thus the null hypothesis was accepted and data was not consistent with either stated directional research hypothesis.

Figure 4.9. Piecewise Regression of Nurse Turnover – Critical Care (incidence of departure per 100 nurses) for 46 Month Period (January 2010 – October 2013).

**Figure 4.9 model statistics.** The analysis of nurse turnover data for critical care nursing units revealed no significant model effect, \( F(2,42) = .46, p > .05, R^2 = .07 \). The piecewise regression coefficients appear in Figure 4.9. Overall, EHR model explained no statistically significant portion of the variance in nurse turnover. The data showed that nurse turnover was flat over the pre intervention period and decreased slightly immediately post EHR followed by a slight increase. Neither coefficients were statistically significantly different with \( p > .05 \). Post EHR there was an increase in nurse turnover over time visualized but not statistically significant.
In the time period of study, during the intervention period of 2011 and one year post intervention period, 2012, the nurse turnover demographic data was summarized by age and years of service. The nurse age ranges by percent turnover year over year is as followed: (a) 64% for 2011 and 53% for 2012 in the 20-30 age range; (b) 24% for 2011 and 29% for 2012 in 31-40 age range; (c) 5% for 2011 and 11% for 2012 in the 41-50 age range; (d) 5% for 2011 and 3% for 2012 in the 51-60 age range; and (e) 2% for 2011 and 4% for 2012 in the 61 and older age range. The percent of nurses who departed from their position by years of service is as followed year over year: (a) 29% for 2011 and 17% for 2012 worked less than 1 year; (b) 59% for 2011 and 57% in 2012 worked in the 1-5 year range; (c) 11% for 2011 and 15% for 2012 worked in the 6-10 year range; (d) 0% for 2011 and 5% for 2012 worked in the 11-15 year range; (e) 0% for 2011 and 6% for 2012 worked in the 16-20 year range; and (f) 1% for 2011 and 0% for 2012 worked in the greater than 21 year range. Although there is slight variation in nurse turnover demographics from years 2011 to 2012, the age and years of service ranges from highest to lowest remained constant from the intervention year through one year post intervention period. The highest nurse turnover was during the age ranges of 20-30 and 31-40, and from nurses who had less than five years experience (see Appendix D).

The human resource exit interview data provided five categories summarizing the reasons why nurses left the institution from years 2011 through 2012. The five categories included: (a) work environment, (b) pay and benefits, (c) management and supervision, (c) co-workers, and (d) personal reasons. The work environment category accounted for 46% of the reasons nurses left the institution followed by personal circumstances at 30%, satisfaction with pay and benefits at 19%, management and supervisory reasons at 5%,
and co-worker information was 0% (see Appendix C). The majority of the nurses who exited the research site during the study period were less than 30 years of age, retained five years or less, and the most stated reasons for departure from the organization were as a result of work environment factors. Work environment factors were described as issues with orientation, scheduling, working conditions, workload, and stress. Nurses leaving the institution sited workload and stress most often as their reason for departure.

Summary

This chapter outlined the results of the analysis of two research questions and their related hypotheses. For research question one, what is the impact of an integrated EHR on nursing practice with the directional hypothesis that quality of care delivered improves over time through innovation adoption. The results show the following:

- The integrated EHR innovation modestly improved the hospital fall rates, the intervention can account for 15% of the portion of reduction post adoption period.
- The Catheter Associated Urinary Tract Infections (CAUTI) results found a sustained improvement in the reduction of rates post EHR intervention and a significant reduction rate decrease from pre and post intervention.
- The Central Line Associated Blood Stream Infections (CLABSI) were statistically significantly improved over time, for every month post intervention the CLABSI rate decreased nearly an infection per ten month period.

Consistent with research question one and two in directional hypothesis two, the implementation of an integrated EHR nurse workflow impacts quality, safety, and nurse
satisfaction during the innovation adoption period followed by improvement from or stabilization to the pre-intervention period.

- Hospital acquired pressure ulcer revealed a slight increase in rates during the implementation period followed by a reduction rate consistent with the pre-implementation of EHR period or the baseline.

- Ventilator Associated Pneumonias (VAP) rates increased somewhat during the implementation period followed by a significant reduction in rates post implementation period. The rate of VAP reduction was higher than the pre-implementation period resulting in nearly the elimination of the infection entirely.

- In addition, the use of Overtime (OT) had a significant change during the implementation, followed by a return to baseline.

- Similarly, there was a slight decrease in staffing, Hours Per Patient Day (HPPD), during the implementation period followed by a return to the pre implementation period state over time. In both the cost outcomes analyzed the post implementation period revealed a rate of staffing hours used consistent to pre-implementation period but at a modest increased rate.

- Nurse turnover data analysis revealed findings that were inconsistent with both research questions and directional hypothesis.

- Medical Surgical nurse turnover pre EHR implementation period was consistent, the rate decreased slightly during the initial implementation period followed by a significant increase for the remainder of the time periods studied. Medical Surgical nurse turnover rates never returned to
baseline. Critical Care nurse turnover rates remained constant during the implementation period, over time the graphical analysis revealed a slight increase post intervention period but not significant.

These findings indicate that overall the use of an integrated EHR tool in nursing practice impacts many quality outcomes. In addition the analysis of EHR adoption over time revealed nursing practice can impact quality and cost measures negatively or positively followed by an improved state or return to pre-implementation period also known as the baseline. An unexpected finding of the study revealed nurse turnover is negatively impacted by the adoption of an integrated EHR as evidenced by an increase in nurse turnover rates post implementation period from the pre-implementation baseline. Human resource data revealed the majority of nurses who left the institution were less than 30 years of age, had five or less years of service, and was a result of the work environment. Organizational nurse exit interviews summarized nurses rated the work environment category the highest, and stress and workload were sited most often as the reason for departure. The diffusion research approach using interrupted time series modeling helped to correlate the relationship of research based innovations with potential users of such innovation in a knowledge-utilization process (Rogers, 2003).
Chapter 5: Discussion

Introduction, Summary, and Background of the Problem

The Electronic Health Record (EHR) movement is predicted to support and improve the delivery, monitoring, and consumption of healthcare services rendered. The implementation of an EHR is multifaceted, and adoption of the innovation is dependent on a complex set of interdependent factors. The widespread adoption of an EHR is a national priority to address the utilization patterns of health care services in our society. Successful adoption of an EHR relies less on technology and more on the environment, clinical readiness, and supportive leadership. The literature analyzed in this study acknowledges that widespread EHR adoption should result in increased efficiency and improved patient care; however there has been little evidence to support a direct relationship between computerized documentation adoption and improved quality of patient care (Jones, Adams, Schneider, Ringel, & McGlynn, 2010).

The primary purpose of an EHR is to capture and retrieve health information. Registered professional nurses are the primary consumers of computerized documentation and responsible for the provision of care as well as the initial interpretation of the human response to care provided. There is a potential that nurses who utilize an integrated EHR tool have improved patient care delivery systems and outcomes, but there is no widespread evidence to support the perception. There is an increasing body of literature emphasizing the unanticipated consequences on quality of
nursing care delivery with the introduction of an EHR in direct nursing practice. The unanticipated consequences include increased costs, increased mortality, and increased hospital acquired conditions (Kutney-Lee & Kelly, 2011). A literature review done by Kutney-Lee and Kelly (2011) found overall medication administration errors and time spent on clinical documentation activities improved with an EHR; similarly, nurse communication and workflows were positively impacted by the introduction of EHR tools.

Innovation adoptions are a challenge in healthcare organizations. The failure to utilize leading science in practice can result in increased cost and patient harm events (Berwick, 2003). The adoption of an integrated EHR tool into nursing care delivery is considered an innovation. The Diffusion of Innovation (2005) theory, by Everett Rogers, was applied to study the efficacy of EHR adoption in nursing. The adoption process is dependent on the following five stages: awareness, interest, evaluation, trial, and adoption. The innovation-decision process is defined as the manner the individual passes through the innovation to decision. The ability for an individual to process innovation adoption through these stages ultimately impacts the person’s ability to maximize a sustainable practice change. DOI theory of decision making factors include previous practice, the individuals feeling of a need or problem, individual’s level of innovativeness, and perceived norms of an individual or social system (Diffusion of Innovation Theory, 2005).

The research setting contained all the five stages of DOI theory. Nurses were aware of the necessary practice change for an integrated computerized documentation workflow because they were currently using a hybrid documentation process. A hybrid
documentation process was defined by the study site as portions of clinical
documentation that are captured in both an electronic system and a paper chart. The
hybrid workflow requires clinicians to interrupt care giving functions to evaluate and
collect clinical information in separate formats. Components of computerized
documentation in the research setting were nurse progress notes, medication
administration, and order entry. On the other hand, care planning and physician orders
were documented in the traditional paper method. The nursing workforce in the research
setting expressed interest in moving toward a new workflow. Nurses had expressed
dissatisfaction with the hybrid documentation system for over two years. Human resource
exit interviews and nursing forums conducted by the Chief Nursing Officer and
recruitment specialist recorded the earliest findings of increased workload concerns in
2009. Nurses in the research setting communicated the need to move toward one
computerized workflow to capture nursing care delivered. Nurses evaluated and trialed
new applications to change the existing paper workflows into a computerized format. The
institution provided the nurses with education and the ability to modify the new
computerized tools as needed to promote engagement. In 2011, the revised workflow
including computerized order entry and care planning were introduced and adopted. The
timely adoption of such a significant nurse workflow enhancement is consistent with DOI
theory. Nurses in the research setting were engaged because they had the ability to
participate in how the practice change was implemented. Adoption of the change was
evidenced by chart reviews and the elimination of paper care plans.

Nurses use EHR tools as memory aids, learning tools for patient care, and an
instrument to modify plans for patient care (Lee, 2006). DOI theory provides a
framework to ensure sustainable adoption of innovation is secured throughout a social system or hospital. Successful EHR adoption throughout a hospital is a challenging, yet crucial task to ensure quality of patient care is delivered. Devices that are easily accessible with nurse specific documentation tools promote adoption of an EHR. In addition, the ability for nurses to use the system and provide feedback enhances nurse engagement and overall confidence with the practice change (DiPietro et al., 2008).

Nurse engagement is essential in the adoption of new innovations such as an integrated EHR. Nurses describe supportive leadership, strong orientation, training time, and interdisciplinary team work as beneficial work environment characteristics. In addition, there are direct associations between the nurse practice environment and work engagement, organizational commitment, and patient safety (Rathert et al., 2009). A favorable practice setting can improve nurse satisfaction and minimize the risk of nurse turnover. Nurse turnover can result from many variables including burnout dimensions, emotional exhaustion, depersonalization, and a loss of personal accomplishment. The risk of burnout leading to nurse turnover can be mitigated by decreasing nursing practice variations (Bogaert et al., 2010). The implications for improving nurse retention in hospitals are improvements in care delivery, but require job empowerment (Smith, Hood, et al., 2005). Nurses identify job empowerment as positive work environments with high levels of nurse involvement at the unit level and autonomy with care delivery tasks (Kotzer & Arellana, 2008).

The research setting participated in annual nurse satisfaction and job enjoyment surveys. From 2009 through 2012 the research site used NDNQI’s RN satisfaction survey to evaluate nurse satisfaction. Organizational RN job satisfaction and enjoyment scores
are presented as modified T-scores. T-scores are a standardized score in which 50 represented the midpoint, and 10 is the standard deviation. Scores below 40 represented low satisfaction, scores from 40-60 represented moderate satisfaction, and scores above 60 represented high satisfaction. All items were scored to reflect the highest score represented the most satisfaction. On average, year after year the research site’s RN overall job satisfaction results scored in the high range at 63. The following sub categories evaluated nurse perception of their work environment averaged over the three years included: (a) task completion, (b) RN to RN interactions (c) RN to physician interactions, (d) decision making, (e) autonomy, (f) professional status, (g) pay, (h) professional development, (i) nursing management, and (j) nursing administration. From 2009 to 2012 nurses rated satisfaction with task completion and pay in the low range from the moderate range post EHR implementation, with a decrease from a score of 41.93 in 2009 to 37.78 by 2012, and 42.76 to 33.13 respectively. The nurses rated their ability to participate in decision making, autonomy, and professional status decreased slightly but not significantly. Nurses perceived the following areas significantly improved over time from moderately satisfied to highly satisfied: RN to RN interaction increased from 67.47 to 69.78, RN to physician interaction increased from 56.98 to 60.54, professional development increased from 63.68 to 65.69, perceptions of nurse managers increased from 59.09 to 62.72. Nurse satisfaction with decision making and nursing administration remained consistent from pre EHR implementation period to post implementation (see Appendix B).

In summary, the research site scored above the national average in overall job satisfaction, opportunities for professional growth and development, and support from
nursing management. The research site scored at the median national average for decision making, job enjoyment, time to perform patient care tasks, and training. Follow up nurse forums in 2011 summarized that the use of an integrated computerized documentation tool improved the quality of documentation and provided nurses with better tools to assist in providing quality patient care. The nurse forums did not provide clear evidence that the integrated EHR positively or negatively impacted time for completion of patient care tasks. Although there was no direct correlation expressed by nurses regarding EHR use and satisfaction, exit interviews along with the forums conducted by the organizations nurse recruitment and retention team from 2011 and 2012 summarized that the environment for nursing practice was overwhelming. Nurses stated, “There was not enough time to provide care at the bedside”; “I didn’t have enough time training and orienting with a consistent preceptor”; and “the workload is too high” (see Appendix C).

Direct care nurse practice environments must be improved to increase the quality and safety of acute care hospitals. Nurse administrators have the responsibility to improve the environment for nurses. There is a potential that the work environment for nurses can be improved with the adoption and integration of EHR tools in direct care nursing workflow. EHR tools provide nurses with patient information that is readily accessible to promote concurrent decision making at the point of care delivery. Ultimately, autonomous nursing practice is dependent on enabling nurses to make patient care decisions based on their practice (Hoffman et al., 2004). Mrayyan (2004) states, “the presence of autonomous and long-serving nurses would have a positive effect on the quality and cost-effectiveness of patient care” (p. 336).
Successful adoption of an integrated EHR into nurse workflow is dependent on nurse perceptions. Over 70% of nurses perceive that EHR tools may lead to improvements in quality nursing care. The research setting of interest was consistent with leading statistics on EHR perception. Nurses in the setting perceived an EHR tool that supported nurse workflow by minimizing hybrid processes would improve quality. Nurses requested tools that were consistent with reminding the nurse of leading practices such as bundles of care for falls, pressure ulcers, and line and catheter management. Positive nurse perceptions are dependent on promoting the strengths and addressing the barriers with EHR use. These factors include having patient care spaces that are conducive to EHR equipment and use, and minimizing the duplication of documentation and interruptions in nurse workflow (Moody et al., 2004). Nurses in the research setting requested barriers to be eliminated such as when complicated documentation is captured, that patient encounters can be streamlined with a copy forward function to modify the computerized chart, as opposed to duplicate documentation of the encounter from the beginning. In addition, nurses at the research site unanimously agreed functioning work stations on wheels were required to maximize concurrent, efficient documentation workflow. Overall, the implementation of integrated EHR tools improved compliance with intended care standards and therefore increased the likelihood of improved quality, such as the reduction of hospital acquired conditions. The EHR can provide valid and reliable results, as well as useful tools to increase the use of quality improvement processes for organizations to achieve federal documentation standards (Persell et al., 2011). Nurses that use an EHR at the point of care when assessing patients have expressed improvements in preventing adverse events (Duffy et al., 2010). In addition,
nurses using EHR tools report more positive work environments (Kutney-Lee & Kelly, 2011).

Although there is a vast amount of literature suggesting the benefits of EHR tools in the delivery of nursing care, few studies have analyzed the impact of EHR use over time. Evidence is needed to better understand workflow integration, effects on quality and productivity, patient and nurse satisfaction, and device selection both at the organizational and direct care level (Cornell et al., 2010).

**Purpose and Research Questions**

The purpose of this study was to determine the impact of an integrated EHR adoption on the quality of nursing care delivered. In addition, this study identified the relationship between EHR tools and the quality, costs, and turnover of a nursing workforce before, during, and following the adoption of a standardized computerized documentation workflow in a targeted hospital setting.

The following research questions were posed in this study:

1. What are the effects on the quality of nursing care delivered including hospital acquired falls, hospital acquired pressure ulcer rates, ventilator associated pneumonia, central line associated blood stream infections, catheter associated urinary tract infections, and costs of care pre, during, and post implementation of an EHR?

2. What is the impact of the integration of EHR tools in direct care nurse workflow on nurse satisfaction over time in one acute care hospital?
Significant Finding and Discussion

The research facility has a longstanding commitment to improve quality and safety. The organization had a documented strategic plan to improve hospital quality and safety by significantly reducing or eliminating hospital acquired conditions; formal performance improvement plans were initiated in January 2010. The hospital used the National Data Base of Nursing Quality Indicators (NDNQI) to track and trend nursing sensitive indicators and the researcher studied the quality and cost outcomes from January 2010 through October 2013. During the onset of the quality improvement plans, the organization pursued evidence based practice standards that promoted the use of care delivery processes using bundles of care or pathways. The EHR tool included many of the bundles of care pathways. The model statistics using piecewise regression analysis revealed the integrated EHR innovation adoption improved the overall state of the hospital’s nursing sensitive indicators.

Research question one asked what are the effects on the quality of nursing care delivered including hospital acquired falls, hospital acquired pressure ulcer rates, ventilator associated pneumonia, central line associated blood stream infections, catheter associated urinary tract infections, and costs of care pre, during, and post implementation of an EHR. The hospital’s fall rate was increasing slightly despite attempts to reduce this hospital acquired condition. The electronic tool included falls assessment risk score and evidence based workflows. Proposed interventions were based on a patient’s falls assessment score and were included in the EHR tool. Nurses were expected to use the falls tools upon admission, during transitions of care, and post fall assessments.

Following the implementation of the integrated EHR into nurse workflow, fall rates
modestly improved. This research study revealed that the EHR intervention can account for 15% of the portion of reduction post adoption period.

Performance improvement records revealed the hospital had undergone a department of health state investigation, and in follow up to the assessment, an intense performance improvement plan to decrease the number of hospital acquired pressure ulcers was in progress from years 2008 through 2009. Subsequently, the hospital’s data revealed a significant decrease in hospital acquired pressure ulcer rates in 2010; the EHR intervention resulted in a slight increase in hospital acquired pressure ulcers during the implementation period followed by a reduction rate consistent with the pre-implementation of EHR period. The increase in rates during the adoption period can be associated with the change in practice and time necessary for adoption. This finding is consistent with DOI theory. The adoption and diffusion of innovations is a complex process that requires time and several stages to result in acceptance (Rogers, Singhal, & Quinlan, n. d.). Performance improvement documents revealed that at the time of implementation, nurses requested improved EHR tools that directly replicated leading practice standards. Modifications were made to the EHR and subsequent improvements resulted. Although not statistically significant, the rate of pressure ulcer improvements pre versus post EHR adoption period was slightly lower visualized graphically ($p=2.8$).

The Catheter Associated Urinary Tract Infection (CAUTI) results found a sustained improvement in the reduction of rates post EHR intervention and a statistically significant rate decreased from pre ($p<.005$) and post intervention ($p<.012$). Similarly, The Central Line Associated Blood Stream Infections (CLABSI) revealed a statistically significant improved rate over time ($p<.01$). For every month post intervention, the
CLABSI rate decreased nearly one infection per ten month period. There was a slight increase in infections during the implementation period, however not statistically significant, and again consistent with DOI theory. Ventilator Associated Pneumonia (VAP) rates increased somewhat during the implementation period, followed by a significant reduction in rates post implementation period (B= -.09, \( p < .001 \)). The rate of VAP reduction was higher with less variation than the pre-implementation period resulting in nearly the elimination of the infection entirely (B= -.24, \( p = .0007 \)).

The integrated EHR workflow into nursing practice using evidenced based documentation tools resulted in expedited reductions for this institution’s progress toward eliminating hospital acquired conditions. Prior to this innovation adoption, this hospital had fragmentation of clinical documentation standards for nurse workflows, such as the separation of data capture from care planning. The implementation of EHR tools that support the majority of nursing care tasks decreased the variation in practice and therefore provided a smoother workflow (Cornell et al., 2010).

The costs associated with innovation adoption can be negatively affected. To understand the impact of EHR on patient outcomes, staffing patterns and costs all must be investigated simultaneously. Conceptually, hospital administration makes decisions about EHR technology as the structure that impacts nurse workflow, or processes that result in labor productivity and quality of care, or outcomes (Furukawa et al., 2011). This study revealed, the use of overtime (OT) had a significant increase during the implementation period (\( p < .01 \)), followed by a return to baseline. Overtime was used slightly less often post implementation than the pre EHR implementation period. Similarly, there was a slight decrease overall in staffing hours visualized; measured in
Hours Per Patient Day (HPPD), during the implementation period followed by a return to the pre implementation period state over time, but no statistical significance was found.

The second research question investigated the impact of the integration of EHR tools in direct care nurse workflow on nurse satisfaction over time in one acute care hospital. Nurse satisfaction can be directly measured in nurse turnover rates. The piecewise regression analysis showed nurse turnover improved during the implementation period followed by a significant increase in nurse turnover rates, particularly in medical surgical and telemetry nursing units, post implementation period ($p<.01$). This finding was inconsistent with the research hypothesis as well as existing literature regarding EHR studies measuring nurse satisfaction. Laschinger & Leiter, 2006, found the nurse practice environment can directly impact burnout with the change in expectations to utilize EHR tools that expand the nursing care delivery expectations. The nursing model of care (or staffing patterns) if not supported, may lead to decreased nurse satisfaction and subsequent turnover. In this research study there are a number of factors that may have contributed to increased nurse turnover. First, although cost was not negatively impacted over time, and in fact, returned to baseline and improved, there may not have been enough supportive resources such as increased nurse staffing over the diffusion of innovation, or change adoption period. Similarly, nurse engagement pre-implementation period was a strength of the research site, but during the change period resources may not have been adequate to revise documentation tools based on nurse feedback in a timely manner. Additionally, the need for clinical experts who could answer questions directly at the bedside were not available. A lack of resources may have contributed to increased stress during the change adoption period. Finally, adequate
hardware may have been a factor contributing to environmental challenges for the nurses. Hardware issues included a lack of functioning workstations on wheels, increased downtime of the computerized tool, and a lack of integration with other bedside devices such as smart pumps for intravenous infusions. These issues arose with no warning time for direct care nurses to prepare a modification to their patient care workflow.

The impact of EHR innovation adoption on nursing quality and costs was associated with significant changes in falls, CAUTI, and CLABSI, consistent with hypothesis one. Hypothesis one proposed nursing quality of care would improve overtime with the use of EHR tools. HAPU’s, VAP’s, and costs measured in OT and HPPD were consistent with hypothesis two, where these outcome measures were negatively impacted at the time of EHR implementation but subsequently returned to baseline and improved slightly over time. The study found nurse turnover was negatively impacted over time with EHR adoption. The researcher again speculates the support structures, including staffing models, may not have adequately supported the change in nursing practice over time, because initially, turnover improved during the implementation period followed by a statistically significant increase greater than the pre EHR implementation period.

**Strengths of the Study**

There are a number of strengths to this study. The study used a wide range of recommendations from previous research to formulate the study’s methodology. For example, the study researched quality impact with the use of EHRs. Additional investigation of EHR use with large organizations using administrative data sets was implemented. Recommendations from previous research encouraged future studies to investigate the impact of EHR implementation on nurse workflow, satisfaction, and
activities (Cornell, Riordan, et al., 2010). In addition, previous studies recommended validating that quality and costs are not significantly, negatively impacted by changes or innovation adoption in nursing practice. The exploration of leading innovations remain the greatest opportunity for our future, however the process of dissemination of innovation requires a great deal of investigation (Berwick, 2003). An additional recommendation for research this study addressed was the concept of using electronic documentation as a form of guidance for quality nursing practice. This study investigated how nurse workflows incorporated into EHR tools can assist in guiding nursing practice. Further research of how alerts improve patient care outcomes in another setting was necessary to measure efficacy in direct care practice (Persell et al., 2011).

A supplementary recommendation from previous research was to investigate multiple dependent variables with the independent variable being EHR implementation adoption. This study successfully measured eight dependent variables simultaneously. This research study used existing secondary and administrative data sets. The strength of this study methodology was a large data set was used to investigate many nursing units in a large urban hospital setting, and was longitudinal in nature. Longitudinal analyses allow the examination of the dynamic nature and impacts of changes in nursing practice outcomes (Laschinger & Leiter, 2006). The data was collected in a consistent manner and little manipulation was necessary. The data collection and analysis was efficient and remained consistent with the research methodology; few barriers in research collection were encountered.
Limitation to the Study

With any research study there are limitations and often contain unexpected barriers. The study’s methodology attempted to mitigate the risks to validation, but still some remained. The only obstacle in data collection was with hospital acquired pressure ulcers. In 2010, the hospital revised data collection methods from point prevalence to concurrent monthly data collection. Initially there were a number of months in 2010 that had missing data, the researcher identified the missing points and notified the hospital’s quality resources department. The missing data points could be extracted from their quality assessment tracking system as opposed to their NDNQI reporting system. The utilization of existing data for the purposes of research can be challenged due to the potential bias. Bias relates to existing data being collected that is not designed conceptually by the researcher. This limitation was addressed through the validation that the organization used industry standard definitions for data collection. In addition, the study’s methodology of interrupted time series outlined tools that were used to validate the data using the smoothed averages approach. This approach normalizes data points over time to be used for the purpose of longitudinal analysis. A major limitation to this study is the recommendation to smooth averages in the ITS methodology. The recommendation is for the data set to have over 50 data points, this study had 46, the researcher consulted with an experienced statistician to confirm 46 data points would in fact provide a valid data set for purposes of this research study. Large data sets, such as the one used in this research study, allow for an examination of infrequent outcomes, having adequate power to detect differences, and account for changes over time (Waltz et al., 2010).
Future Research

In performing this study, a number of recommendations for further research were discovered. These new areas of interest came from the data analysis and additional questions that were identified based on the research findings, along with existing literature. First, further understanding of the clinical practice environment is necessary for innovation adoption; both the technological tools, as well as the actual equipment necessary for successful EHR adoption at the point of care delivery. Little is known about nurse workflow environmental factors to promote care delivery; EHR use is another component of an already complicated practice environment. Additional research is necessary to study how nurses can be supported to document concurrently (Cornell et al., 2010). There are a variety of EHR tools that promote quality care. Existing research is lacking on the type of computerized tools that would both promote adoption and enhance the quality of documentation. Nurse engagement is critical to successful innovation adoption; future research should focus on how to engage nurses directly. Understanding empowerment factors can increase nurse health and wellbeing to improve retention (Laschinger & Finegan, 2005). Future research studies are warranted regarding how nurses utilize EHR tools for decision making. Decisional involvement from the RN has been associated with positive patient care outcomes, including fewer hospital acquired conditions (Jaafarpour & Khani, 2011) Expanded knowledge related to how and when nurses use EHR tools in direct practice is essential for sustainability of an EHR investment.

Further research is necessary regarding nurse turnover during innovation adoption. This research identified an unanticipated outcome; the significant increase in
nurse turnover post EHR implementation. The turnover may have been a result of a number of factors including, but not limited, to staffing practices, generational factors, and additional lack of required nurse training. Continued research is necessary to identify RN turnover risks and mitigation strategies following innovation adoption. By adopting a nursing view of empowerment, healthcare settings could recognize a needed expansion of the nursing role (Sieloff, 2010).

Finally, this topic would benefit from further research in the area of leadership characteristics, and the development of supportive infrastructures within the hospital setting. Innovation adoption can increase frustrations experienced by professionals in bureaucratic settings. The rigidity of hierarchical settings, such as hospitals, has stifled nursing practice and empowerment and led to a loss of control, which in turn may contribute to the profession’s retention issues (Laschinger & Havens, 1996). The application of servant leadership principles within a healthcare learning environment, such as EHR adoption, could enhance outcomes and promote retention. Further qualitative research on factors impacting EHR adoption, decision making by nurses, and nurse executives leadership characteristics will also strengthen the existing body of research (Neill, Hayward, & Peterson, 2007).

**Implications for Research, Practice, Education, and Executive Leadership**

The results of the study lead to implications for research, practice, education, and executive leadership. The findings of this research study contribute to the existing body of literature by determining that the quality and costs of care, when implementing an EHR, are not significantly negatively impacted. Overall, the quality of care improved or remained consistent with past hospital performance. Duffy and Kharasch (2010)
determined a significant, marginal improvement regarding nursing quality outcomes and this study supports those findings. In addition, this study adds to existing literature with the finding that nurse turnover statistically significantly increased post implementation period. The hospital under investigation had a stable nurse turnover rate prior to EHR implementation; post EHR implementation, the nurse turnover rate increased significantly. This is a new finding that adds to the existing body of literature.

The results of this study lead to recommendations for practice. The first, is prior to implementing EHR tools, nursing care pathways should be clearly defined, evidenced based, and incorporated into the EHR tool. The ability to have nurse driven tools may impact engagement, promote decision making, and improve patient care. Decisional involvement for nurses is directly correlated with nurse engagement at the unit level. Strong decisional involvement in nursing leads to higher perceived quality of patient care. “Efforts to improve the quality of the nursing work environments into decisional involvement are critically important to sustaining a strong nursing workforce in the future” (Jaafarpour & Khani, 2011, p. 16). According to DOI theory, innovation adopters need to know how the change will impact them personally, or whether the relative advantage of offering tools that are specific to nursing practice will increase the likelihood of utilization and potentially improve decision making at the point of care delivery. Nurses have provided feedback that the relative advantage of computerized documentation has to be better organized. Improvements in the tools will decrease stress, prevent delays in the charting that directly impact interdisciplinary communications and decision making for the healthcare team (Lee, 2004).
This study also reinforces that innovation adoption, such as EHR implementation, is a process. The complex environment of care delivery can impact successful adoption and should be measured as a process over time. Using Rogers’ DOI theory provides a specific outline to explore the factors contributing to how an innovation is accepted by a group of individuals. Rogers’ DOI theory is applicable and should be considered when implementing changes in the future. Findings of this study should encourage nurses and change agents to look deeper into each component of DOI theory: relative advantage, compatibility, complexity, trialability, and observability as the process of change, and support each component uniquely.

Staffing models need to be considered during change adoption. The results of this study acknowledge that cost of care was not significantly affected. However, this finding may inform the higher than expected nurse turnover results over time. The impact of EHR implementation on nurse staffing might vary by the level of sophistication of the EHR, user, and phases of adoption (Furukawa et al., 2013). Effective nurse staffing models should include the amount of nurses for the number of patients, unit complexity, individualized patient needs, and the competency of the nurses caring for patients during the change adoption period and beyond. Supportive staffing models should be nurse driven. The findings indicate that the cost of nursing care using an integrated EHR tool does not statistically decrease significantly. A recommendation for practice would be to increase staffing during the implementation period and throughout the adoption phases. Direct nursing care hours with a staffing effectiveness model may eliminate the risk of hospital acquired conditions during the implementation phase, as well as reduce nurse turnover.
The results of the study lead to implications and recommendations for education. Nurse turnover was statistically significantly increased immediately post intervention period and sustained the rate increase one year post implementation period. Institutional data found that nurses who have worked less than five years and are younger than 30 years of age turnover at a greater rate than experienced nurses during change adoption. In addition, nurses sited the work environment category most often as contributing to their reason for departure. Recommendations for nursing education include concept based education regarding change adoption in the nurse practice environment. Nurses being prepared to adapt to the ongoing changes in the practice environment will promote capacity, readiness for change, and knowledge that innovation adoption takes time. A recommendation for nursing education is to incorporate concurrent clinical documentation practices into a simulated environment. The ability to capture and respond in real time the ongoing changes in a patient’s condition requires both functional training and critical thinking abilities. Understanding the EHR tool is essential for nurses to be proficient with the expectation to capture ongoing responses to changes in patient’s condition and should be simulated in the academic experience prior to providing direct clinical care. EHR proficiency, the provision of nursing care tasks and nurse critical thinking can no longer be separate functions, all three must be integrated into nurse workflow to promote decision making, and ultimately the nurse practice environment.

The nurse practice education environment should promote case based scenario orientation experiences, particularly for nurses with less than five years of experience. Many institutions continue to orient transitioning nurses with didactic, functional task based EHR skills only; this learning environment fails to prepare new nurses with the
skills and information necessary to use the EHR for decision making and communications amongst the healthcare team. Providing case based scenario orientation experiences along with the didactic, task based learning environment will support nurses to integrate the EHR tool in their practice and view the tool as an asset to providing care as opposed to increasing stress with additional tasks to complete.

There are many implications of this research for executive leadership. Nurse executives must consider the deeper vision necessary to achieving a successful EHR implementation, and the actual and potential effects on patients and nursing practice. The nurse executive’s vision must include an infrastructure that supports engagement from every level of the healthcare organization (Moore & Hutchinson, 2007). Formal and informal structure is necessary. The nurse leader who empowers their nurse followers can directly impact the work environment satisfaction. The relationship between nurse leader’s empowerment behaviors, perceptions of staff empowerment, and work environment can be associated with Kanter’s theory of structural empowerment. Kanter’s theory describes that work behaviors and attitudes are in response to an employee’s position and circumstance within an organization (Greco et al., 2006). Power is defined as, “the ability to mobilize resources to get things done” (Greco et al., 2006, p. 29). Nurse leaders should develop an infrastructure that is inclusive and serves employees at every level of the organization from strategic planning through implementation of innovation adoption. There are seven facilitative leadership practices found in the literature: (a) share the vision and inspire followers, (b) stay focused on results, processes, and relationships with employees, (c) maximize employee involvement at all times, (d) develop action
oriented structures, (e) foster consensus based decision making, (f) counsel towards performance, and (g) celebrate all milestones (Moore & Hutchison, 2007).

Formal structures need to include multidisciplinary committees, individual nurse practice meetings to design lean, informative tools that contribute to nursing care and prevent redundancy in computerized documentation. A supportive infrastructure should include intentional pilot programs that provide change adopters with the ability to test, and provide input to the change system prior to the implementation period, and formal debriefings throughout the change process should occur. Capturing the rich information is essential to ensuring the executive leader is well-informed on the results of the vision and plan. Informal structures, such as executive leader rounding and direct care practice, allow time to work alongside nurses and other change adopters.

Ultimately, while the executive leader accepts the accountability to create and promote change that is fiscally and ethically responsible to an organization’s mission, vision, and values, the executive leader should consider servant leadership characteristics to support change adoption. Multiple studies have reported that support from nurse leaders increases nurse autonomy and participation in decision making (Mrayyan, 2004). The servant leadership approach, from both hospital administration and direct supervisory roles, such as nurse managers, promotes engagement for nurses. Servant leadership characteristics, such as caring for others, listening, empathy, healing awareness, persuasion, conceptualization, foresight, stewardship, commitment to people’s development, and building community, were introduced in healthcare through the Institute of Medicines (IOMs) report, “To Error is Human” (Waterman, 2011). This report identified that the lack of support and communication in healthcare can lead to
patient harm (Garber, Madigan, Click, & Fitzpatrick, 2009). The servant leader supported environment has been perceived as positive by nurses to enable effective practice with other health care professionals (Garber et al., 2009). Swearingen and Lieberman (2004) described factors that contribute to low job satisfaction in nursing could be positively impacted through a servant leadership approach. “While the future of health care is vitally dependent upon our knowledge of sound business principles, simply being good businesspeople without being conscientious servant-leaders who care will not ensure our success” (Swearingen & Lieberman, 2004, p. 106).

The nurse leader who empowers their nurse followers can directly impact the work environment and patient care outcomes. Executive leaders have a responsibility to their workforce, patients, and the communities with which they serve to use their positional power to ensure healthcare resources are ethically rendered. Power is defined as, “the ability to mobilize resources to get things done” (Greco et al., 2006, p. 43). There is a direct relationship between executive leadership and excellent patient care outcomes. Healthcare executives have the ability and responsibility to improve the level of safety in their healthcare systems by creating an environment that is inclusive and supportive to promote professional nursing practice (Jaafarpour & Khan, 2011).

The adoption of integrated EHR tools is an innovation that has demonstrated improvements in various quality and safety outcomes in healthcare. Electronic tools that provide guidance regarding evidence based practice incorporated into direct care nursing workflow can promote decision making for nurses by capturing information at the point of care delivery. Successful EHR adoption can be described through DOI theory and by addressing the four concepts associated with the theory. The four concepts included in
DOI are innovation, or for the purpose of this paper, a change, communication channels, time, and the social system (Diffusion of Innovation Theory, 2005).

Conclusion

The use of an integrated Electronic Health Record (EHR) may improve the overall quality and cost management of patients in the hospital setting. The purpose of this research was to measure the impact of an EHR innovation adoption on the quality of nursing care delivered. A comprehensive review of the literature was conducted and revealed that nurse adoption and the integration of an EHR into direct clinical practice can affect patient quality and safety outcomes, and nurse satisfaction. Gaps in the literature were found regarding how nurses adopt EHRs into their direct care practice, the need for further research on independent variables that may enhance or prevent adoption, and organizational support structures that would promote adoption and complex clinical decision making. Additional research was determined to be necessary to investigate the impact of EHR adoption on nursing care delivery.

This research study used the Diffusion of Innovations theory to investigate two hypotheses of study. The first hypothesis of study was that nursing quality, satisfaction, and costs improve over time once the innovation or change was integrated into nurse workflow. The second hypothesis of study was that the implementation of integrated EHR tools impacts quality, safety, and nurse satisfaction during the onset of the innovation adoption period followed by stabilization (or a return to baseline). A retrospective analysis, an interrupted time series (ITS) model of a large data set was analyzed at the point of nursing care one year pre-implementation, at the point of implementation, and one year post implementation period of an integrated EHR nurse
workflow. The following research questions were studied. What are the effects on the quality of nursing care delivered including hospital acquired falls, hospital acquired pressure ulcer rates, ventilator associated pneumonia, central line associated blood stream infections, catheter associated urinary tract infections, nurse retention, and costs? The second research question was this: what is the impact of the integration of EHR tools in direct care nurse workflow on nurse satisfaction over time in one acute care hospital?

The findings for research question one were the integration of an EHR innovation modestly improved the hospital’s fall rates, the intervention accounted for 15% of the portion of reduction in the post adoption period. The Catheter Associated Urinary Tract Infections (CAUTI) had a sustained improvement in the reduction of rates post EHR intervention and a significant reduction rate decrease from pre to post intervention period. The Central Line Associated Blood Stream Infections (CLABSI) were statistically significantly improved over time, for every month post intervention the CLABSI rate decreased nearly an infection per 10 month period. The findings for research question two were that hospital acquired pressure ulcers showed a slight increase in rates during the implementation period followed by a reduction rate consistent with the pre-implementation of EHR period or the baseline. Ventilator Associated Pneumonias (VAP) rates increased somewhat during the implementation period followed by a significant reduction in rates post implementation period. The rate of VAP reduction was higher than the pre-implementation period resulting in nearly the elimination of the infection entirely. Costs associated with nursing care had a significant change during the implementation period followed by a return to baseline. The indicator that was inconsistent with both research questions was nurse turnover. The data showed the turnover rate decreased
slightly during the initial implementation period followed by a significant increase for the remainder of the time periods studied.

These findings indicate that overall the use of an integrated EHR tool in nursing practice impacts many quality outcomes. In addition, the study shows the diffusion of innovations, EHR adoption over time in nursing practice can impact quality and cost measures negatively or positively followed by an improved state or return to pre-implementation period. The study adds to the existing body of research and contributes to the formation of an evidenced based model to support organizations innovation adoption such as the implementation of an EHR; this study further clarified the practice environment of RNs. The research findings highlight changes or innovation adoption in nursing practice and the impact on the quality, safety, cost, and satisfaction over time. Changes in direct care nursing practice can be perceived by nurses as both positive and negative depending on the type of change. Diffusion of Innovations theory provides insight into the stages and processes to successful adoption of changes in nursing practice. The success of innovation adoption, such as an integrated EHR, is dependent upon an organization’s ability to support DOI. Ultimately, supporting the nurse practice environment pre implementation, during implementation, and post implementation period is essential for successful EHR adoption in healthcare.

The findings of this study contribute to the existing body of research regarding EHR adoption. Most significantly, quality and costs are not negatively impacted by the adoption of integrated EHR tools, in fact, quality, safety, and cost indicators may improve overtime. In addition, this study found nurse turnover increased overtime with the adoption of an EHR; this finding is new to the existing body of research. Implications
for nursing practice are that the use of EHR tools that are evidenced based inform nursing practice and provide concurrent information of both nursing care provided and patient’s response to those interventions. The ability to have nurses possess a tool at the point of care delivery that informs their practice allows for improved decision making. This study supports the emerging relationship between the use of EHR tools and nurse use of the electronic information to improve critical thinking and knowledge to deliver patient care. Adequate support for DOI is necessary for successful adoption of an EHR. Although the finding from research question two was unanticipated, successful adoption of an integrated EHR workflow may negatively affect nurse perceptions. Perceptions in practice of EHRs include workflow problems, fragmentation of documentation and increased time needed away from direct patient care. This study found that nursing costs measured in nursing hours utilized did not increase over time.

For successful innovation adoption the nurse practice environment has to be modified and supported; care delivery models need to be adjusted. Support includes ongoing staffing evaluations, timely revisions to the computerized tool based on nurse feedback, and adequate clinical devices with fewer incidences of downtime. This study confirms that nurses have the ability to positively impact the quality of patient care through successful innovation adoption. The utilization of evidenced based EHR tools that are integrated into nursing practice at the point of care delivery decreases the risk of hospital acquired conditions. Additional implications for nursing practice is that the utilization of an integrated EHR can improve nurse critical thinking time and abilities by having patient discrete data findings available at the point of providing essential nursing care functions. These findings readily inform the nurse of the patient’s condition and
therefore allow the nurse to individualize patient care nursing interventions. Consistent with DOI theory, adoption of an innovation such as an EHR may affect outcomes at the time of implementation and although the quality improves or returns to pre-implementation overtime, the effects on patient safety may be positively or negatively affected during the early adoption phase.

The implications of this research for health care leaders include an obligation to investigate, support, and involve nurses in every stage of innovation adoption to mitigate the potential for negative impacts on patient care and to provide the highest quality of care delivery during diffusion of innovations. This study opens the door to ask questions about the traits of executive leadership qualities to improve diffusion of innovations. Servant leadership characteristics have the potential to support structures with complex organizations to be modified for the purpose of enabling leadership at all levels. In addition, this study further broadens the concept of nurse’s decisional involvement both at the organizational and direct care practice levels to improve the overall quality of patient care delivery.

Recommendations for education are both for the academic and nurse practice education experiences. Simulation and case based scenario education is recommended to promote the use of the EHR tool into concurrent nursing practice. The EHR tool must be taught and adopted by nurses as an integrated tool to promote the environment of practice versus another task to complete. Ultimately, supporting with education EHR documentation practices at the point of nursing care delivery will enhance the nurse practice environment by the reduction of stress and workload. The ability for the nurse to have critical patient information to promote clinical decision making will improve quality
care. The education environment has to incorporate the EHR tools while teaching nursing tasks to prepare new nurses for the expectations in practice.

The diffusion of innovations, such as the implementation of an integrated electronic health record, using servant leadership principles to support nursing care delivery, improves the overall performance of acute care hospital environments by enhancing decision making for registered professional nurses.
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Appendix A

David Churchill, MD
Chairperson, Research Committee
November 1, 2013
St. Joseph’s Hospital Health Center
301 Prospect Avenue
Syracuse, NY 13203

Dear Dr. Churchill:

This is a request for exempt status for a retrospective study related to St. Joseph’s Hospital Health Center’s quality, cost, and safety data. Exempt status is being requested related to minimal to no risk to patients due to the anonymity of data being utilized. Please review the detailed information below regarding the study.

I. STUDY TITLE “The Impact of Electronic Health Records on the Quality of Nursing Care Delivered”

I would like to apply to the IRB to analyze quality and cost data in an acute care hospital where there has been innovation adoption, such as EHR use, in direct care nurse workflow.

Study Design: Using a Large Retrospective Quality Data Set, Quantitative, Descriptive Study
Study Dates: January 2010 through year to date 2013

Innovation adoption in healthcare has evolved to promoting organizational effectiveness in response to the increased complexity in high quality healthcare environments. Computerized documentation is not a new concept, but little is known about nurse’s adoption to this innovation and the effects on the nurse practice environment. Over the past decade, a rapid increase in the adoption of innovations such as Electronic Health Records (EHR) has occurred. The purpose of this research is to investigate the impact of EHR tools on the quality of nursing care delivered. Adoption of EHR tools provide critical information to improve nurse decision making. The proposed study includes the following research questions: the impact on the quality of nursing care delivered prior to and one year following the implementation of an EHR innovation, does adoption of an EHR tool improve nurse turnover rates, and is there a relationship between EHR use and nurse satisfaction.

The study would investigate the relationship between EHR use and the effects on: Hospital Acquired Conditions (falls, pressure ulcers, catheter associated urinary tract infections, central line infections, and ventilator associated pneumonias), cost (hours per patient days and overtime use), and nurse satisfaction (turnover rates and nurse satisfaction rates).

II. STUDY DESIGN
Retrospect Data Analysis and Retrospective Chart Review
The source of data analyzed is from the National Data Base of Nursing Quality Indicators (NDNQI) from 2010 through 2013, and existing organizational data from the human resource and performance improvement departments. The hospital has reported nursing sensitive indicators and cost outcome measures to the NDNQI database for over ten years. Nursing sensitive indicators are defined as hospital acquired falls and pressure ulcers. Cost outcome measures are defined as hours per patient day (HPPD), and the utilization of overtime pay practices.

The NDNQI is the only national database that provides quarterly reporting of staffing and outcome measures at the unit level, with over 1000 organizations represented. The sample data measures events per 1,000 patient days. Additional sources of data include human resource information of nurse turnover from 2010-2013, the total number of nurses by quarter that exited the institution, 2010 and 2013 annual nurse satisfaction survey outcomes. Approximately ten medical surgical units and two critical care unit data would be included, all other specialties excluded.

Thank you in advance for your time. Please feel free to contact me with questions or comments. I can be reached at annemarie.czyz@sjhsyr.org or 315.448.5885.

Sincerely,

AnneMarie W. Czyz, RN, MSN
Vice President/CNO
St. Joseph’s Hospital Health Center
November 13, 2013

AnneMarie Czyz, RN, MSN
Vice President/CNO
St. Joseph’s Hospital Health Center

Dear AnneMarie:

Your study SJHIR8285 "The Impact of Electronic Health Records on the Quality of Nursing Care Delivered" at St. Joseph’s Hospital Health Center is granted "exempt" status.

It is important to note that the Research Committee be notified immediately if any of following occur:

• significant deviations from the approved protocol;
• serious complications or untoward effects result from the investigation;
• closing of the study;
• results of the study being written up for presentation or publication (any manuscript must be submitted to the Administration Office prior to presentation or publication).

If you have any questions or issues, please feel free to contact me at 315-472-7504.

Sincerely yours,

David Churchill, M.D.
Chairperson, Research Committee
November 14, 2013

AnneMarie Czyz
301 Prospect Ave
Syracuse, NY 13203

Dear Ms. Czyz:

Thank you for submitting your research proposal to the Institutional Review Board.

I am pleased to inform you that the Board has approved the proposal entitled, "The Impact of Electronic Health Record (EHR) Innovation Adoption on the Quality of Nursing Care Delivered."

Following federal guidelines, research related records should be maintained in a secure area for three years following the completion of the project at which time they may be destroyed.

Should you have any questions about this process or your responsibilities, please contact me at 385-5262 or by e-mail to emerges@sjfc.edu.

Sincerely,

Eileen M. Merges, Ph.D.
Chair, Institutional Review Board

EM: jlm

Copy: OAA IRB
IRB: Approve exempt.doc
Appendix B

Nursing Satisfaction Data:

<table>
<thead>
<tr>
<th>Year</th>
<th>Tasks</th>
<th>RN-RN Interaction $^a$</th>
<th>RN-MD Interaction $^a$</th>
<th>Decision-making</th>
<th>Autonomy $^a$</th>
<th>Professional Status $^a$</th>
<th>Pay $^a$</th>
<th>Professional Development $^a$</th>
<th>Nursing Management $^a$</th>
<th>Nursing Administration $^a$</th>
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<tr>
<td>2009</td>
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<td>42.7</td>
<td>63.68</td>
<td>59.09</td>
<td>50.53</td>
</tr>
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<td>2011</td>
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<td>65.40</td>
<td>58.98</td>
<td>46.24</td>
<td>48.70</td>
<td>63.22</td>
<td>45.1</td>
<td>63.76</td>
<td>58.53</td>
<td>52.84</td>
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<tr>
<td>2012</td>
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<td>69.78</td>
<td>60.54</td>
<td>46.32</td>
<td>47.00</td>
<td>62.56</td>
<td>33.1</td>
<td>55.69</td>
<td>62.72</td>
<td>55.09</td>
</tr>
</tbody>
</table>

2009-2012 NDNQI Nurse Satisfaction Comparison for St. Joseph's Hospital Med/Surg

<table>
<thead>
<tr>
<th>Year</th>
<th>Tasks</th>
<th>RN-RN Interactions $^a$</th>
<th>RN-MD Interactions $^a$</th>
<th>Decision-making</th>
<th>Autonomy $^a$</th>
<th>Professional Status $^a$</th>
<th>Pay $^a$</th>
<th>Professional Development $^a$</th>
<th>Nursing Management $^a$</th>
<th>Nursing Administration $^a$</th>
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</tr>
<tr>
<td>2011</td>
<td>58.16</td>
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<tr>
<td>2012</td>
<td>57.78</td>
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<td>60.54</td>
<td>46.32</td>
<td>47.00</td>
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<td>33.1</td>
<td>55.69</td>
<td>62.72</td>
<td>55.09</td>
</tr>
</tbody>
</table>
Appendix C

EXIT QUESTIONNAIRE SUMMARY
Reporting Period: January – June 2011

Frequency Rated as an important reason for Leaving (3 or 4)

<table>
<thead>
<tr>
<th>Work:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>5</td>
</tr>
<tr>
<td>Schedule</td>
<td>16</td>
</tr>
<tr>
<td>Working Conditions</td>
<td>17</td>
</tr>
<tr>
<td>Work Load</td>
<td>21</td>
</tr>
<tr>
<td>Stress</td>
<td>21</td>
</tr>
</tbody>
</table>

Comments:
- Nurse-patient ratio too high.
- Feel new nurses are pushed too fast.
- Hired D/E – past few months work more E’s.
- Call and OT are very high.
- I had to work more and more late shifts and OT.
- Workload is very high.
- Very heavy patient assignments.
- Patient loads make this position one of the most stressful that I have had.

Pay and Benefits:

<table>
<thead>
<tr>
<th>Pay and Benefits:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual review &amp; pay increase policy</td>
<td>3</td>
</tr>
<tr>
<td>Equity in pay practices</td>
<td>3</td>
</tr>
<tr>
<td>Rate of Pay</td>
<td>7</td>
</tr>
<tr>
<td>Benefit Package</td>
<td>6</td>
</tr>
</tbody>
</table>

Comments:
- The pension plan is not enough money to live on.
- Time off, retirement, and pay prompted me to look outside St. Joe’s for opportunity.
- WE differential is standard at other institution.
- Hired part time and had to pay more for benefits.
- Pension – not enough.
- I think not only the RN should have gotten a raise – LPN should get one also; they do most of the work!
- 401 K match amount is low.

EXIT QUESTIONNAIRE SUMMARY
Reporting Period: January – June 2011

Management & Supervision:

<table>
<thead>
<tr>
<th>Management &amp; Supervision:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition for work performed</td>
<td>7</td>
</tr>
<tr>
<td>Sensitivity to needs</td>
<td>9</td>
</tr>
<tr>
<td>Consistency in carrying out policies</td>
<td>6</td>
</tr>
<tr>
<td>Support provided</td>
<td>8</td>
</tr>
<tr>
<td>Other: Communication -</td>
<td>1</td>
</tr>
</tbody>
</table>
Comments:
Communication was not as effective as it could be, there often was not email communication, nor could I find minit meetings.
Unit cannot provide the flexibility needed for those going on for education.
Feel managers don’t step up to cover for call in’s on “off” shifts + WE.
The new nurses are too overwhelmed + need the help.
Recognition of my hard work
Nurses feel like their concerns were not taken seriously.

<table>
<thead>
<tr>
<th>Co-Workers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperation</td>
<td>5</td>
</tr>
<tr>
<td>Friendliness</td>
<td>4</td>
</tr>
<tr>
<td>Technical Competence</td>
<td>4</td>
</tr>
</tbody>
</table>

Comments:
Feel some staff isn’t competent.
Sometimes hard to get people to work together.
RN’s texting up at the pods all day, training for 6 month + great team work is no longer there.

EXIT QUESTIONNAIRE SUMMARY
Reporting Period: January – June 2011

<table>
<thead>
<tr>
<th>Personal</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Relocation</td>
<td>13</td>
</tr>
<tr>
<td>School (Further Education)</td>
<td>7</td>
</tr>
<tr>
<td>Personal Health</td>
<td>5</td>
</tr>
<tr>
<td>Child Care (Day Care)</td>
<td>3</td>
</tr>
<tr>
<td>Elder Care</td>
<td>2</td>
</tr>
<tr>
<td>Family Needs</td>
<td>0</td>
</tr>
<tr>
<td>Flexible Hours</td>
<td>0</td>
</tr>
</tbody>
</table>

Comments:
Work is not allowing me to take the final class.
I will have the opportunity to go back to complete my BSN.
Don’t have to sign a contract for Tuition assistance.
Child of elder care.
Moving or relocating.

Would you recommend SJHIC to a family member or friend?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>1</td>
</tr>
</tbody>
</table>

Comments:
My experience here was great.
Yes to Hospital; no to Homecare.

5/20/2014G:\DOCUMENT\NURSDOC\WP6DOC\LINDA.C\Year End Separation Reports\Exit Questionnaire Summary Jan - June 2011.docx

128
Working here has been wonderful.
My recommendation would depend on the individual.
For healthcare only – not to be an employee.
Absolutely, great values, excellent employees.

**What did you like best about working at SJHHIC?**
Great “family” of co-workers.
Everyone is friendly.
The compassion and team.
The management was excellent.
The wonderful staff.
Relationship with patients and co-workers.
Great Hospital, I met many nice caring individuals over the years.
High standard of care.

**EXIT QUESTIONNAIRE SUMMARY**
**Reporting Period: January – June 2011**

**What did you like least about working at SJHHIC?**
Lack of breaks + lunch.
The increasing work load and lack of autonomy.
Desk work.
Inflexible schedule and long hours were down played.
Pt. acuity has been high.
The schedule – specifically having to work two shifts (N’s); weekends, holidays, sometimes with no lunch.
Work load too much, charting system is overwhelming and very stressful.
Benefits.
The unsafe staffing that resulted from call-ins and low staffing members.
Lack of recognition for LPN’s who work hard.
I don’t like the way LPN’s are treated.
Communication.
Pension/lack of Pension.
12 hour evening shifts.
Nurse to pt. ratio, assignments very often more than a nurse could physically and emotionally handle.

**Please summarize your main reason for leaving.**
Better schedule.
I needed a change.
To have a more consistent schedule.
Career advancement.
Scheduling and Administration, lack of support.
Joined a Travel Agency.
An opportunity to work in Physician’s Office.
Moving from Syracuse.
Relocating to another State.
An opportunity to secure a much better benefit package (pension, better match 401 K program etc…)
Significant increase in pay.
To pursue education.
Family obligations.
Driving distance.
Retirement.

Please add any comments or suggestions you feel may benefit current and future St. Joseph’s Hospital employ

<table>
<thead>
<tr>
<th>New Employer Type of Setting:</th>
<th>Hospital</th>
<th>MD Office</th>
<th>Insurance</th>
<th>Ambulatory</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increase in Pay:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
EXIT QUESTIONNAIRE SUMMARY  
Reporting Period: 2012

Frequency Rated as an important reason for Leaving (3 or 4)

<table>
<thead>
<tr>
<th>Work:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
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</tr>
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</tr>
<tr>
<td>Work Load</td>
<td>22</td>
</tr>
<tr>
<td>Stress</td>
<td>25</td>
</tr>
</tbody>
</table>

Comments:
Night shifts, weekends. Due to class schedule it was hard to work & then have classes. Too many people to train at one time. Too much time with computers and not with patient. Transfers from ED come back to back & no time to prepare & complete notes from previous admission before next one comes. Here late to complete paperwork. Leaves around 4:30 pm if works days to complete work. Orientation was better on 2-4 then SICU. Feels she connected better with preceptor on 2-4. Primary Care works well depending on staffing & patient total care & efficiency of co-workers. Orientation to charge was inconsistent. Workload is better now that there is primary nursing. Workload is a stressor-changes heavy & sometimes unrealistic for single shift. Charge orientation was not consistent. Had 12 different preceptors. Charge orientation was not consistent.

Pay and Benefits:

<table>
<thead>
<tr>
<th>Pay and Benefits:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual review &amp; pay increase policy</td>
<td>9</td>
</tr>
<tr>
<td>Equity in pay practices</td>
<td>4</td>
</tr>
<tr>
<td>Rate of Pay</td>
<td>4</td>
</tr>
<tr>
<td>Benefit Package</td>
<td>9</td>
</tr>
</tbody>
</table>

Comments:
Tuition is huge. Just got BSN from Keuka. Reimbursement was not enough & repayment requirement to work 3 years. Did not want to commit. Going for MSN in the fall & can’t take out loans. Upset about no 2% merit raise. Missed deadline for tuition repayment. Letter never received for forgiveness for late application.
Comments:
Staff morale is very good and they are very happy to have Karen Thompson as their new manager. Management can only do so much sometimes. It has to come from higher up. My manager & coordinators have always been helpful & willing to work with me. The hospital changes policies to fit any need at any time. Communication is gone. Often the person bringing the patient to 2-4 is not the nurse taking care of them which slows care & adds stress to try to find out what’s going on with the patient. (99% of the time)
Management is excellent on 2-4. See all the new buildings and equipment the hospital is paying for but did not say thank you to staff by giving them the 2% merit raise. High regard for Karen LaFrance. No enough communication. Lunch never set up – never coverage for patients. Can’t attend in-services or lunch. Since Deirdre came things are much better. Deirdre oriented her & stabilized the unit.

Co-Workers:
| Cooperation | 8 |
| Friendliness | 8 |
| Technical Competence | 5 |

Comments:
All good no concerns. I love my coworkers and I’m sat to leave them especially at this time. Physicians are inappropriate to the nurses & even to manager. Team work is very good when patients are crashing. Does not like mocking and disrespect & no culture sensitivity. Some Pas are rude to the nurses (cardiology PAs). Felt she did not fit in.

EXIT QUESTIONNAIRE SUMMARY
Reporting Period: 2012

Personal:
| Relocation | 33 |
| School (Further Education) | 8 |
| Personal Health | 15 |
| Child Care (Day Care) | 7 |
| Elder Care | 6 |
| Family Needs | 1 |
| Flexible Hours | |

Comments:
Stress level affecting health-being followed by Dr.

Would you recommend SJHHC to a family member or friend?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>5</td>
</tr>
</tbody>
</table>

Comments:
There are so many new people it’s hard to find an experienced person. Lack of Retirement. Understaffed and the hospital is expanding too fast.
EXIT QUESTIONNAIRE SUMMARY

Reporting Period:

What did you like best about working at SJHHC?
Making a difference in patients’ lives.
Gaining more knowledge in a teaching & friendly atmosphere.
My 1-8 staff.
Ability to work a personal schedule.
Staff on 2-4.
Magnet Recognition, primary care, but really need more staff to do it well.
Management, friendly atmosphere.
Co-workers
Equipment
Working with cardio care unit, staff, superiors/very accommodating.
The mission, the caring, friendly environment
Flexible schedule.
Great learning experiences and a place I can say I am proud to have worked at.
Felt like family.
People & culture

What did you like least about working at SJHHC?
Having to leave for 60 days to become Per Diem.
Short staffing and opening of new units without adequate staff. It is unsafe for patients and the nurses.
Retirement plan.
Workload, lack of appreciation, too many changes in the wrong direction with not enough time to regroup.
Workload seems to increase week to week.
Heavy patient load and always being asked to stay and work over scheduled time. Same people always stayed & same people always said no.
Unit always short staffed and everyone was overworked.
Lack of nurse appreciation. Not all 4th floor coordinators are consistent with verbal or small recognitions.
Lack of help so staff could take lunch.
In-consistency in carrying out policies.
Delay of professional growth & development. Unfair circumstances.
Scheduling.
Inadequate staffing issues leading to stress among co-workers. Operational challenges that are obvious yet remain unchanged (i.e. admission process, interaction with ER, bed management issues).
Orientation was disorganized.
Baldrige Moment starting & Introduction of new ideas, lack of follow thru & enculturation before bringing on something else new. Difficulty staying committed.
Mentoring
Home Care environment overwhelming
Excessive charting
Did not feel part of Home Care team.
Politics and inconsistency
People’s attitudes
No professional advancement
Ortho team/surgical techs.
Floating
The focus often is on serving as opposed to teaching self reliability and making the patient more responsible for their outcome.

Please summarize your main reason for leaving.
Overwhelming workload, too many new people not enough seasoned staff, no appreciation for job well done, lack of pension, lack of ETO/sick time.
Retirement
My job has become too stressful. I feel I am “drowning” almost on a daily basis. I also want straight day scheduling.
Going home to help care for a family member.
Benefits are not very good. Especially in helping nurses with tuition/retirement plan.
One hour commute.
Desire for new experience and work consistent hours for maximum employee’s performance & satisfaction.
Better job offer in prior field, less physically demanding.
Relocation
Not a good fit.
The demands of my full time position have exceeded my expectations and require my full focus at this time.
Health issue.
Unable to work nights.
Education
Physical Health (back surgery)
Obtained FNP
Offered opportunity for promotion at another facility. I did not see an opportunity like this one for me here in the near future. I have a Master’s Degree in Nursing Administration.
Job opportunity

Please add any comments or suggestions you feel may benefit current and future St. Joseph’s Hospital employees.

New Employer Type of Setting:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>MD Office</th>
<th>Insurance</th>
<th>Ambulatory</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>6</td>
<td></td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

Increase in Pay:

| Yes | 19 | No | 14 |
## Appendix D

### RN Resignations Medical-Surgical Critical Care 2011 - 2012

<table>
<thead>
<tr>
<th>Cost Center</th>
<th>Unit</th>
<th>Emp ID</th>
<th>Reason</th>
<th>SepDate</th>
<th>UnitLOS</th>
<th>HospLOS</th>
<th>Age</th>
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<tbody>
<tr>
<td>6014</td>
<td>1-4</td>
<td>10575</td>
<td>Obtain position/diff job exp</td>
<td>April 11, 2012</td>
<td>1</td>
<td>1</td>
<td>26</td>
</tr>
<tr>
<td>6014</td>
<td>1-4</td>
<td>11866</td>
<td>No NYS licensure</td>
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<td>&lt;1</td>
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<td>23</td>
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<tr>
<td>6014</td>
<td>1-4</td>
<td>1650</td>
<td>Relocating/Employee initiated</td>
<td>July 12, 2012</td>
<td>19</td>
<td>19</td>
<td>61</td>
</tr>
<tr>
<td>6014</td>
<td>1-4</td>
<td>10098</td>
<td>Relocating/Employee initiated</td>
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<td>&lt;1</td>
<td>23</td>
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<tr>
<td>6015</td>
<td>1-5</td>
<td>9198</td>
<td>Obtain position/diff job exp</td>
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<td>2</td>
<td>4</td>
<td>24</td>
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<tr>
<td>6015</td>
<td>1-5</td>
<td>9029</td>
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<td>41</td>
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<tr>
<td>6015</td>
<td>1-5</td>
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<td>46</td>
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<td>51</td>
</tr>
<tr>
<td>6015</td>
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<td>11060</td>
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<td>September 10, 2012</td>
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<td>1</td>
<td>27</td>
</tr>
<tr>
<td>6015</td>
<td>1-5</td>
<td>8705</td>
<td>New jobs-promo/advancement</td>
<td>September 30, 2012</td>
<td>4</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>6015</td>
<td>1-5</td>
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<td>Compensation or Pay</td>
<td>September 10, 2012</td>
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<td>28</td>
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<td>6018</td>
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<td>11398</td>
<td>Did not return from LOA</td>
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<td>&lt;1</td>
<td>25</td>
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<tr>
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<td>39</td>
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<td>10313</td>
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<tr>
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<td>2-4</td>
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RN Resignations 2011 - age
RN Resignations 2012-length of service

- less than 1 year: 17%
- 1-5 years: 57%
- 6-10 years: 15%
- 11-15 years: 5%
- 16-20 years: 6%
- 21+ years: 0%