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AN EXAMINATION OF THE ADOPTION OF ELETRONIC
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THROUGH THE UNIFIED THEORY OF ACCEPTANCE AND
USE OF TECHNOLOGY LENS

presented by

BREE E. HOLTZ

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of the requirements for the

Ph.D. degree in Communication Arts and
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**AN EXAMINATION OF THE ADOPTION OF ELECTRONIC MEDICAL
RECORDS BY RURAL HOSPITAL NURSES THROUGH THE UNIFIED
THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY LENS**

By

Bree E. Holtz

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ABSTRACT

AN EXAMINATION OF THE ADOPTION OF ELETRONIC MEDICAL RECORDS BY RURAL HOSPITAL NURSES THROUGH THE UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY LENS

By

Bree E. Holtz

Electronic medical records (EMR), the computerized storage and retrieval of patients' health data, have the potential to improve the quality of healthcare services, reduce medical errors and lower medical costs. Despite these benefits, health care providers have traditionally been slow in the adoption of these systems. Past research on EMRs tends to focus on physician perceptions and their adoption tendencies, even though nurses are the frontline of patient care and have a great deal of patient charting responsibilities. This study sought to understand the intended adoption behaviors of nurses during an EMR implementation through utilization of the unified theory of acceptance and use of technology (UTAUT) model.

Mixed methods were used to better document the adoption perceptions of nurses during an EMR (McKesson's Paragon Order Management) implementation. The first phase was conducted via an online survey with nurses (n=113) from Marquette General Hospital (MGH) at their last Paragon training

session. The second phase used an interview guide with nurses (n=31) from MGH's intensive care unit/critical care unit (ICU/CCU) to further explore the findings from the survey. The results suggest that social influence was the strongest predictor of intended adoption behaviors, however, performance expectancy was still a significant indicator of adoption behavior. Additionally, a social network was sketched to display the interactions of the ICU/CCU nurses in regards to the EMR, in order to provide a more in-depth view of social influence during the EMR deployment. The implications of this study indicate the need to better understand the role of social influence and organizational parameters such as shift and unit in order to advance theory and prescribe solutions to enhance diffusion and adoption of EMRs.

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To my husband, family, & friends

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I. INTRODUCTION

Health care in the United States is facing many challenges that will have to be addressed in order to continue to provide quality patient care. One of those challenges is a growing shortage of health professionals, including both physicians and nurses. Even during the recent recession beginning in late 2007, the health care sector has continued to grow (Bureau of Labor Statistics, 2009). The United States Bureau of Labor Statistics reported in July of 2009 that approximately 20,000 health care jobs were added to the workforce, which most industries reported losses. However, this good economic news for health care workers has important implications for the future of health care. The U.S. nursing (registered nurses) shortage is projected to increase to 260,000 by 2025, largely due to the rapidly aging workforce (Buerhaus, Auerbach, & Staiger, 2009). Buerhaus stated, "a large and prolonged shortage of nurses is expected to hit the U.S. in the latter half of the next decade" (p. 2422, 2008). The effect of these shortages on patients includes longer hospital stays, delays in receiving care, worsening health outcomes, and increased medical errors (Talsma, Grady, Feetham, Heinrich & Steinwach, 2008; Buerhaus, 2008).

The cost of health care is another challenge facing the health care industry. The estimated share of the Gross Domestic Product (GDP) from health care was 16.2 percent in 2008 and rose to 17.3 percent in 2009, which is the largest one year increase in history (Sisko, Truffer, Smith, Keehan, Cylus, Poisal, et al., 2009; NHE, 2010). National health care spending was \$2.5 trillion in 2009 and is expected to increase to \$4.5 trillion in 2019 (NHE, 2007). As costs and

the shortage of health care workers, specifically nurses, continue to rise, many solutions have been presented. Health information technology (HIT), specifically electronic medical records (EMR), have been cited as one way to help overcome these concerns (Karsh & Holden, 2006; IOM, 2001).

The call for implementation of EMRs started gaining momentum in the early 1990s. When the Institute of Medicine (IOM) called for massive improvements in the health care system, including nationalized patient records (Dick & Steen, 1991). The benefits of these computerized records include improved patient safety (reduced errors), increased efficiencies, and lowered costs. Even though health care professionals and policymakers appreciate the benefits of computerized patient records, additional calls to action for deployment were required. A decade later, the IOM produced two additional reports calling for health care reform: *To Err is Human* (2000) and *Crossing the Quality Chasm* (2001). *To Err is Human* is now considered to be a seminal report for health care reform by declaring that approximately 98,000 people per year died due to a medical error. In order to improve this statistic and the quality of care, the IOM developed six guidelines: to provide care that is (1) safe, (2) effective, (3) patient-centered, (4) timely, (5) efficient, and (6) equitable (Kohn, Corrigan & Donaldson, 2000; Johnson, Pan, Middleton, Walker, & Bates, 2003). The second report, *Crossing the Quality Chasm* proposed a strategic plan to address the issues presented in *To Err is Human*. Computerizing patient health data was cited as being an important part of facilitating all six guidelines.

In 2004, President George W. Bush stated that by 2014 all United States citizens should have a nationalized EMR (Blumenthal & Glaser, 2007).

Currently, President Barack Obama is continuing this mandate and is formulating incentives for implementation, adoption and use of EMR systems and penalties for non-adoption in health care organizations (Baer & Mihalich-Levin, 2009).

These incentives are being established because the implementation and diffusion of EMR applications has been extremely slow. Blumenthal (2009) reports that less than two percent of hospitals have a fully comprehensive EMR in all units and less than eight percent have basic EMRs. However, 75 percent of hospitals have electronic lab reports and image files. In an ambulatory setting, four percent of physicians have a fully functional EMR, thirteen percent have a basic EMR system, sixteen percent have purchased a system but have not yet implemented it and 26 percent are planning to purchase an EMR system within the next two years (Blumenthal, 2008).

EMR systems have been shown to improve the access and quality of care by allowing clinicians to see more patients (IOM, 2001). This is because an EMR system allows all patient data to be available to the health care providers quickly and in a centralized location. Also, EMRs have the potential to reduce redundant tests and reduce medical errors (through allergies alerts, drug interactions alerts, etc.), thereby saving money (Sittig, Kuperman, & Fiskio, 1999). While the benefits of EMRs are widely cited, adoption of them still remains low. Some of the adoption challenges include technical issues, policy concerns, organizational

factors, interoperability, lack of internal resources and financial concerns (Bahensky, Jaana, & Ward, 2008; Beacon Partners, 2010).

Rural hospitals and health care facilities are even further behind many of their urban counterparts when it comes to health information technology adoption (Grant, Campbell, Gruen, Ferris & Blumenthal, 2006; Schoenman, 2007; Brooks, Menachemi, Burke & Clawson, 2005). These rural facilities are often at a tremendous disadvantage when implementing EMR systems because they are generally smaller and less complex (Schoenman, Keeler, Moiduddin, & Hamin, 2006; Casey, Wakefield, Coburn, Moscovice, & Loux, 2006). These facilities typically have lower profit margins due to their heavy reliance on Medicare and Medicaid patients. The IT workforce and expertise is also limited in many of these areas (Frisse & Metzger, 2005). The rural setting magnifies the challenges faced by all health care organizations.

As EMR systems are becoming more prevalent and will be mandatory in health care facilities in the near future, research into successful adoption is becoming increasingly important. This research project has two goals: the primary goal is to quantitatively examine the intended adoption by hospital nurses regarding an EMR implementation; the secondary goal is to better understand the adoption characteristics through an exploratory study of nurse social networks regarding the EMR system in a single department of the hospital.

Nurses are often cited as the frontline of care, however, there has been little theoretically driven research on their adoption perceptions of EMRs. Research regarding nurses' social networks is also limited, and an improved

understanding may be able to better inform the adoption characteristics taking place. This research utilized the unified theory of acceptance and use of technology (UTAUT) model to determine how nurses from Marquette General Hospital (MGH) perceive the adoption of an EMR application (Paragon Order Management). In particular, this research examines the intensive care and critical care unit (ICU/CCU) at MGH to better understand how the social network regarding the Paragon system emerged during the implementation process. The results from this study could help guide researchers and hospital management in developing better strategies for a successful EMR implementation and help to further develop adoption theories.

Chapter two includes a literature review of several key topics germane to this area of research and also presents the hypotheses and research questions that guide this study. Chapter three provides a description of the methodology employed for this project. Next, in chapter four, the results of this research are presented. Finally, the findings of this report are discussed, including the implications, limitations and possible future research opportunities in this area of study.

II. LITERATURE REVIEW

The scope of past research regarding electronic medical records (EMR) is substantial; it covers many topic areas and fields (e.g., medical, social, technical, etc.). However, there has been little theoretically-based research about the adoption characteristics of nurses and their social structures during an implementation. This chapter provides a review of the literature pertinent to this research and is divided into five sections. The first section provides a background on EMR systems, including a review of their impact on health outcomes, medical costs, provider satisfaction and commonly cited barriers to adoption. To conclude this section, a summary of “meaningful use” of EMR is presented, as this is the measurement the U.S. government is using to determine the incentives and penalties related to EMR utilization. The second section provides information about nurses working in the United States, including their tasks and responsibilities. The third section is a description of an intensive care unit/critical care unit (ICU/CCU). This study examined this unit to acquire further insight into the adoption tendencies of nurses. The fourth section provides a summary of the theoretical foundations utilized in the research, including a description of the unified theory of acceptance and use of technologies (UTAUT) and its constructs. Through this discussion, the hypotheses that drove this project are also presented and explained. The final section summarizes social network analysis and the work that has been conducted with health professionals. As the social network analysis for this research is exploratory and the secondary goal, several research questions were developed for this study

and are presented in this section.

Electronic Medical Records

Recording individual medical data first appeared in the 19th century as a means for physicians to remember the details of each patient (Shortliffe, 1999). It was not originally meant as a method for communication among several providers or as a place for multiple lab and test results. This written record no longer fully meets the needs of the providers or the patients, therefore utilizing information technology has been thought of as a way to overcome the many shortcomings of the paper record (Shortliffe, 1999). Storing patient health data in electronic medical records has recently received a lot of interest, although the idea of storing patient information electronically was first documented in the 1960's (Pinkerton, 2006). Larry Weed, then at the University of Vermont, working with a group of physicians and information technology experts devised a system that would generate a record of patient information from all providers, also allowing for third party verification of diagnosis (NASBHC, 2010). In the early 1970's the Regenstreif Institute in Indiana created one of the earliest electronic record and decision support systems (Overhage, 2005). Through these years there have been many iterations of this type of electronic storage of medical information and patient data.

Some of the more prominent applications include electronic medical records (EMR), electronic health records (EHR), electronic patient records, (EPR), computerized patient records (CPR) and personal health records (PHR). EMR refer to the electronic records maintained within a clinic, private

practitioner's office, hospital or other health organization (Nagle, 2007). EMR systems normally integrate data from all departments of a hospital or clinic (e.g., emergency department, radiology, pharmacy) (Hayrinen, Saranto, & Nykanen, 2008) and many incorporate some level of clinical decision support tools (e.g., allergy alerts, drug interaction alerts) (Bates, Ebell, Gotlieb, Zapp, & Mullins, 2003). The International Organization for Standardization (ISO) (2004) has defined EHR as secure electronic warehouses where patient data are stored, exchanged, and are retrievable by multiple authorized users. The difference between EMR and EHR has historically been defined by whom the patient record is shared with; EMR sharing typically remains within the organization, while an EHR can be shared with any clinician provided they have the proper security credentials. Recently, the terms EMR and EHR have become interchangeable. EHR is the term used most frequently in policy, as "health" implies a complete view of an individual's medical experience (Deutscher, Hart, Dickstein, & Horn, 2008). EPR and CPR have similar definitions whereby all or most of the patient's clinical data are stored in a particular hospital or clinic, however, these systems are not as comprehensive as EMR systems (Hayrinen, Saranto, & Nykanen, 2008). PHR are characterized by allowing the patients themselves to populate and control access to their records (Ackerman, 2007). Popular web-based applications of PHR systems include Microsoft's HealthVault and Google Health. This research utilizes the term EMR to be consistent with the language that Marquette General Hospital has used during the planning and implementation of their electronic data storage system.

Past Research

There has been a broad array of research published to date on EMR systems due to their importance in the future of health care. Some examples include understanding the impacts of electronic medical data privacy and security (Mandl, Szolovits, & Kohane, 2001; Barrows & Clayton, 1996; Willison, Keshavejee, Nair, Goldsmith, & Holbrook, 2003), usability and design issues (Sittig, Kipperman, Fiskio, 1999; Jaspers, Steen, Bos, & Geenen, 2004; Zhang, 2005, Kushniruk, Triola, Borycki, Stein, & Kannry, 2005; Brandt, 2008), and data accuracy and quality (Wagner & Hogan, 1996; Peabody, Luck, Jain, Berenthal, & Glassman, 2004; Staroselsky, Volkm, Tsurikova, Pizziferis, Lippincott, Eald & Bates, 2006). These studies are comprised of a variety of important issues and research objectives that seek to better understand the impacts of EMR. However, when specifically examining the implementation and adoption issues of these systems much of the past research has studied the health outcomes, costs, user satisfaction, and barriers to an EMR adoption.

Health outcomes

Improving health outcomes is an important issue in all aspects of health care and is a significant motivator for any health professional. Preliminary studies have indicated that there are improved health outcomes associated with the utilization of EMR systems for conditions such as diabetes (Kimbler & Peterson, 2006), chemotherapy (Schumeister, 2005), pediatric care (Hoagwood et al., 2002), mental health care (Gruber-Baldini, Boustani, Sloane, & Zimmerman, 2004), and smoking screening and cessation counseling (Spencer,

Swanson, Hueston, & Edberg, 1999). Additionally, a reduction in adverse drug events (ADE) is one of the most widely cited health outcomes that are improved through use of an EMR system (Leape, Cullen, Dempsey Clapp, Burdick, Demonaco, Erickson, et al., 1999; Bates, Leape, Cullen, Laird, Petersen, Teich, et al., 1998; Raschke, Gollihar, Wunderlick, Guidry, Leibowitz, Peirce, et al., 1998; Bates, 2000; Wolstadt et al., 2008; Wu, Lapore & Unger, 2007; Bates, Spell, & Cullen, 1997; Hillestad et al., 2005; Jacobs, 2007; Kuo, Folan Mullen, McQueen, Swank, & Rogers, 2007). ADEs occur when a provider gives a patient the wrong drug, the wrong dose of a medication, uses the wrong delivery technique, misses a dose, or there is a drug-drug interaction (AHRQ, 2001). For instance, research comparing cardiac patients over a 12-month period found that those with an EMR were more likely to be on the correct drug, have lipid-related goal levels met, and have better documentation of treatment, compared to those that were still using paper records (Kinn et al., 2001). Asch and colleagues (2004) also established that using EMRs improves clinical performance and provides higher quality of care for patients with a chronic disease in the Veterans Health Administration. Recent research has also demonstrated that the utilization of EMR systems has significantly improved many patient quality measures (McCullough, Casey, Moscovice, & Prasal, 2010).

However, some research suggests that there are some mixed outcome results when an EMR has been employed (Yoo, Molis, Weaver, Jacobson, & Juhn, 2007; Kazley & Ozcan, 2008). For instance, when comparing electronic records to paper records in a health system, Tsai and Bond (2007) found that

documentation was more complete using electronic records, however many of the quality indicators were suboptimal in both the paper and the electronic records, therefore overall outcomes remained similar. Another study, which sought to associate better health outcomes with use of an EMR system in small clinics, found that there was no significant interaction between higher patient care quality and EMR systems (Linder, Ma, Bates, Middleton & Stafford, 2007). The researchers speculated these results could be due to many factors including the fact that the EMR application may have not been complete, it lacked full utilization by the health care providers, and these clinics did not have the financial or technical support many of the larger health systems have. However, they were able to find positive results in some categories like smoking cessation. Zhou and colleagues (2009) also examined health outcome indicators at facilities where EMRs were implemented, finding that “simply having an EMR may not sufficiently improve the quality and safety of health care” (p.457). These research findings may be an indication that the EMR systems are not being fully utilized and are not integrated into the everyday work processes of these facilities (Wu & Straus, 2006; Crosson, Ohman-Strickland, Hahn, DiCicco-Bloom, Shaw, Orzano, et al., 2007). These studies also suggest that current (paper) documentation requirements may be substandard and this process is not changing with the implementation of an EMR. However, much of the research posits that positive health outcomes could be achieved over time through better training, clinical decision support, and with full utilization of the systems.

Medical costs

Health outcomes and the cost of care are often associated themes among EMR researchers. The reduction of ADE, shorter hospital stays and better management of chronic conditions are examples of how EMR systems have demonstrated a reduction in medical costs. However, much of the research that has examined costs has been unable to demonstrate any definitive results (Furuno, Schweizer, McGregor, & Pernceovich, 2009). Still, there are some promising indications that EMRs do assist in containing these costs. As the adoption of these systems becomes more prevalent, additional longitudinal data will become available, possibly leading to more conclusive results in the future.

Current research has established that ADE are a major expenditure to the health care system, estimating the cost of each ADE to be anywhere between \$2162 and \$4685 (Wu, Laporte, & Unger, 2007; Wolfstadt et al. 2008; Bates, Spell, & Cullen, 1997). The Agency for Healthcare Research and Quality (AHRQ) (2001) states that these errors can be reduced up to 84 percent through the utilization of EMR systems. Others estimate these savings could total more than \$81 billion annually (Wolfstadt, Gurwitz, Field, Lee, Kalkar, Wu, et al., 2008; Hillestad, Bigelow, Bower, Girosi, Meili, & Scoville, 2005; Fisher, Vogeli, Stedman, Ferris, Brookhard, & Weissman, 2008).

Wang and colleagues (2003) performed a comprehensive cost-benefit analysis of EMR, which sought to estimate the financial benefit or cost of implementing and maintaining an EMR system in a primary care setting over a five-year period. The analysis utilized several indicators at varying levels, finding

there were few scenarios that did not yield net gain. This prompted the researchers to conclude that “implementing an EMR can yield a positive return on investment” (p.402). However, a limitation to that study was how the data were collected; for instance, the data were from one hospital setting, based on past literature and expert opinion. Yet, this type of data collection is common practice in evaluating the return on investment (ROI) for EMR systems (Menachemi & Brooks, 2006). These ROI studies are generally limited in setting, analyzing a single component of the EMR (e.g., e-prescribing) or have been case studies. Menachemi and Brooks (2006) suggest these types of studies are indicative of the challenges in measuring costs within a health care setting.

Satisfaction

Demonstrated cost savings and better quality of care can help improve users' satisfaction with an EMR system. These initial attitudes have been demonstrated to be important in determining the effectiveness of their adoption (Whitten, Buis, & Mackert, 2007). Overall, past research suggests that physician perceptions have been positive, however, once implemented, some physicians have expressed mixed feelings toward the application stemming from their perceptions of control loss (Blegind, Jensen, & Aanestad, 2007; Whitten, Buis, & Mackert, 2007; Joos, Chen, Jirjis, & Johnson, 2006). Others suggest that over time these perceptions may become more positive. For example, El-Kareh and associates (2009) conducted a longitudinal study over a 12-month period and discovered that physician perceptions of an EMR improved by the end of the analysis. Furthermore, nurses have demonstrated higher satisfaction rates with

EMR systems when compared to physicians in several studies. The research suggests that they perceive these systems to be beneficial in their daily work (Likourezos, Chalfin, Murphy, Darcy, & Davidson, 2004). Wagner and colleagues (2008) propose that higher reports of nurse satisfaction could be the result of the organization they examined, which initially focused on this group. Another inquiry into nurse perceptions found high satisfaction with the EMR system by nurses only when it assisted them in delivering high levels of quality patient care (Dillion, Blankenship, & Crews, 2005).

Barriers to adoption

Even though this innovation has been in existence for over five decades and has demonstrated some benefits to health outcomes including the reduction of medical errors, improved costs and satisfaction among health care providers, the adoption of these types of systems remains low (Blumenthal, 2009). There have been many reasons for this low implementation rate including concerns over privacy and confidentiality of patient information (Tang, Ash, Bates, Overhage, & Sands, 2006), lack of standards and interoperability of systems (Hersh, 2004) and the high upfront costs of designing, implementing and transferring over to an electronic system (Loomis, Ries, Saywell, & Thakker, 2002). Since the federal government is mandating use of EMR, these barriers may be overcome through incentives such as reimbursement for systems and rewards for “meaningful use”.

Meaningful Use

Meaningful use is a measure by which the federal government can assess if a certified EMR system is being utilized in a way that promotes improved health care and quality (Blumenthal, 2009). Meaningful use is an incentive structure that can help take the majority of the financial burden off of the provider when implementing an EMR. The American Recovery and Reinvestment Act of 2009 authorized over \$40,000 in Medicare incentives to eligible physicians for the implementation and use of an EMR system (Blumenthal, 2009). In order to receive these payments, some examples of the functions that must be employed include: having at least 80 percent of patients with at least one entry of structured data; computerized physician order entry (CPOE) used for at least 80 percent of pharmacy, lab, and radiology orders; having drug warnings (drug-drug, drug-allergy, etc.); making certain data available for exchange between facilities, providers, and patients; and possessing the capacity to submit electronic data to immunization registries (Hogan & Kissam, 2010). This incentive structure may be the necessary push for providers and health care organizations to install and use EMR systems.

Summary

While not entirely conclusive, past studies of EMR system adoptions have confirmed there are improved patient quality measures, decreases in medical costs, and satisfaction among most health care providers. However, adoption of information technologies in the health care setting has lagged behind most professional industries (Clancy, 2006). This is particularly true of EMR

technologies. Challenges to their adoption include high implementation costs, lack of internal resources, interoperability concerns, and work processes adjustments (Middleton, Hammond, Brennan and Copper, 2005; Shortliffe, 2005; Beacon Partners, 2010). Given the importance of widespread adoption of EMR systems in a national effort to improve health care, the current state of implementation leaves many opportunities for research into the many facets of the application. As nurses play a large part in health care delivery and in the successful implementations of EMRs, it is essential to focus on this stakeholder group to enable significant conclusions to be made.

Nurses

Nurses work in a range of settings and handle a variety of patient care issues. Their work includes treating and educating patients and their families on a variety of conditions, illnesses, and general well being (Bureau of Labor Statistics, 2008). Their responsibilities also include recording patient histories, measuring vital signs, administering treatments and performing follow-up patient care (Bureau of Labor Statistics, 2008). Nurses are often the frontline of patient care and provide important and crucial patient information to physicians, acting as a liaison between patients, patient families and physicians (American Nursing Association, 2004).

Nurse demographics

Registered nurses (RNs) represent the largest group of health care providers in the United States (Bureau of Labor Statistics, 2008). It is a female-

dominated position, where approximately 94 percent of the workforce are women (Health and Human Services, 2004). Just over 60 percent of RNs are between the ages of 35 and 54, with an average age of 46.8 years old (Health and Human Services, 2004). RNs work in all types of health care facilities; however, hospitals remain the largest employer of RNs, employing almost 57 percent of the nurse population (HRSA, 2007). RNs perform a variety of work in a hospital setting including administrative, laboratory, research, and direct patient care. The top five work units of direct patient care are general/specialty inpatient units (28.3%), critical care units (17%) outpatient departments (9.1%), emergency departments and operating rooms (8.7% each) (Health and Human Services, 2004). In 2004, the highest current degree obtained by RNs is as follows: diploma (17.5%), associates degree (33.7%), baccalaureate degree (34.2%) and masters or doctoral degree (13%). Approximately, eight percent of the RN population is prepared as an advanced practice registered nurse (APNs), including clinical nurse specialists (23.7%), nurse anesthetists (12.9%), nurse midwives (4.3%), nurse practitioners (51.1%) or a combination of those (8%) (HRSA, 2007).

Past research

Even though nurses represent the majority of health care providers, much of the research regarding the adoption and implementations of EMR systems has been focused on physicians (Stubenrauch, 2009). Considering that nurses are a primary stakeholder in the health care system, it is important to understand their adoption tendencies in order to develop successful implementation and training

strategies through theory-driven research. Past investigations of IT adoption by nurses tend to provide descriptions of their perceptions of satisfaction of having an EMR system (Hegney, Eley, Buikstra, Fallon, Soar, & Gillmore, 2006; Bickford, Smith, Ball, Grantz, Panniers, Newbold, et al., 2005; McLane, 2005). Lærum and colleagues (2004) set out to explore the differences in satisfaction among several types of professionals using EMR: medical secretaries, nurses, and physicians. They found that the medical secretaries demonstrated the highest satisfaction rates, likely due to the nature of their work and environment. Several other studies examining the satisfaction of nurses using an EMR system suggest that nurses are overall satisfied with the systems, generally more than physicians, and are most concerned with the quality of patient care through EMR utilization (Dillion, Blankenship, & Crews, 2005). Additionally, researchers have established that nurses generally favor EMR systems, but feel that improvements can be made to the applications (Darr, Harrison, Shakked, & Shalom, 2003; Likourezos, Chafin, Murphy, Sommer, Darcy, & Davidson, 2004). Others researchers have examined the importance of training (McCain, 2008; Ferrell & DeBord, 2003).

Bickford and associates (2005) explored the impact of nurse training and its impacts on their perceptions of the system, finding that they were able to document higher rates of satisfaction after these training sessions. Further research has explored the improvement in nurse documentation when using an EMR, suggesting that documentation is more complete and the retrieval of information is faster (Hakes and Whittington, 2008; Moody, Slocumb, Berg, and

Jackson, 2004). Additionally, research investigating the system alignment of the work processes specific to nurses has also been conducted, establishing that higher overall positive perceptions can be attained through a better system integration (Courtney, Demiris, & Alexander, 2005; Bickford et al., 2005). The primary purpose of this study is to document the adoption characteristics of the nurses at MGH, the secondary goal was to further explore these findings through a study of a specific hospital unit. The Intensive Care Unit/Critical Care Unit (ICU/CCU) was selected because this unit represents a critical mass in the hospital. This unit also houses the majority of the nurses at MGH, who care for the most critical patients. The department also heavily relies on electronic patient data capture, storage, and retrieval. This unit provides care to all patient types and because of this, there are many different groups of health care professionals throughout the hospital tied to this unit.

Intensive Care Unit/Critical Care Unit

An intensive care unit/critical care unit (ICU/CCU) in a hospital typically employs many nurses. The ICU/CCU environment is fast-paced, multi-disciplinary, and requires nurses to be knowledgeable about all patient categories (Farid Gulli, Nasser, & Sampson, 2010). The ICU/CCU provides a high level of care to patients who need to be monitored continuously. Brill and colleagues (2010) state that nurses in an ICU/CCU provide clinical assessment, diagnosis, and develop patient treatment plans. The ICU/CCU is very often characterized by being a high technology environment because of the various types of medical monitoring equipment used (Sado, 1999). Past research

examining the utilization of EMR systems in the ICU/CCU has frequently centered on provider satisfaction, documentation time, quality of care, and patient safety (Sado, 1999; Green, Gilhood, Logie, et. al., 1996; Fontaine, Speedie, Abelson, & Wold, 2000; Stockwell, 2006.) There has been some examination into how the ICU/CCU's social networks are structured, however, these studies have mainly focused on patient care coordination between other departments within the health system (Gitell & Weiss, 2003). There has been little rigorous and theoretically-based research that addresses EMR application implementation from a nurse perspective; this type of knowledge is necessary in order to ensure successful adoption and long-term use of EMR systems. Therefore, this project utilizes a theoretical lens in order to better understand the adoption of EMR by nurses.

Theoretical Underpinnings

There are multiple theories that examine the acceptance of technology in an organizational setting. One of the most popular models is the technology acceptance model (TAM). The TAM is the first model developed specifically to understand the adoption of information technologies by individuals within a business setting (Wills, El-Gayar, and Bennett, 2008). The TAM, developed by Davis (1989), assumes that perceived usefulness and perceived ease of use will influence an individual's decisions about using a new technology. Later, the model was further extended by including social influence and cognitive norms constructs, often referred to as TAM2 (Venkatesh and Davis, 2000). There have been a multitude of studies, which have sought to appreciate technology

acceptance specifically among health care professionals via TAM (Yarbrough & Smith, 2007; Chismar & Wiley-Patton, 2002; Handy, Hunter, & Whiddett, 2001; Holden & Karsha, 2009). However, many researchers dislike the TAM because it has several limitations, including its lack of falsifiability (Silva, 2007), the use of “perceived ease of use” as a proxy for self-efficacy (Straub & Burton-Jones, 2007) and the fact that individual differences are not accounted for (Agarwal & Prasad, 1999).

Due to the weakness of the TAM and the many other adoption models available, researchers sought to create a broad and uniform model of acceptance. Therefore, the unified theory of adoption and utilization of technologies (UTAUT) model was developed by the convergence of eight theories that strive to explain behavioral intentions and usage behavior of IT (Venkatesh, Morris, Davis & Davis, 2003). All of these theories have a foundation in the fields of sociology and psychology (Straub, 2009). These models include, the theory of reasoned action (TRA), theory of planned behavior (TPB), technology acceptance model (TAM), combined TPB-TAM, social cognitive theory (SCT), motivational model (MM), model of PC utilization (MPCU), and innovation diffusion theory (IDT).

Foundation of the UTAUT

Many of the theories used as a foundation of the UTAUT are intention-based models. For example, the TRA posits that an individual's behavior is determined by their behavioral intention to perform a specific action. Fishbein and Ajzen (1975) suggest behavioral intention is a function of two factors,

attitude and the subjective norm. The TRA has been used as the basis for many other theories of technology acceptance. The TPB is one of those theories; it added the of construct perceived behavior control as an additional determinant of intention (Eagly & Chaiken, 1993). Also derived from the TRA is the SCT, which states an individual's behavior is an interaction of personal determinants, behavior, and the environment (Bandura, 1977). The SCT is attempts to predict both individual and group behavior, and understand how a change in any one of the determinants can influence the others (Bandura, 1986).

Other theories used in developing the UTAUT model include MPCU, the MM and the diffusion of innovation. The MPCU model was largely developed from human behavioral research done by Triandis (1977) and seeks to predict actual use behavior and not the intention to use (Thompson, Higgins, & Howell, 1991; Venkatesh, Morris, Davis & Davis, 2003). The MM characterizes much of the social behavior literature, which contends that motivation is key to understanding an individual's behavior. The two main constructs defined in MM literature are extrinsic motivation and intrinsic motivation. Siracuse and Sowell (2008) observed that extrinsic motivation is similar to perceived usefulness as defined in TAM. Finally, the diffusion of innovation strives to predict how new ideas and innovations permeate a group, community or society over time (Rogers, 2003). Moore and Benbasat (1991) have tailored this theory to specifically examine technology adoption. Furthering that work, Karahanna and colleagues (1999) have provided greater understanding to the predictive qualities of the constructs of diffusion.

UTAUT constructs

Venkatesh and colleagues (2003) developed a unified model of acceptance by collapsing these eight models, to advance acceptance of technology theory and create a more succinct model. The researchers state that there are four key determinates of use intention and use behavior those are performance expectancy, effort expectancy, social influence and facilitating conditions in the UTAUT model.

Performance expectancy (PE) is defined as the degree to which an individual believes that a technology will assist them in performing job duties (Venkatesh, Morris, Davis & Davis, 2003). PE was developed through combination of several constructs from the eight models, including perceived usefulness, outcome expectancy, relative advantage, job-fit and extrinsic motivation. Effort expectancy (EE) is defined as the degree to which an individual perceives a particular technology to be easy to use (Venkatesh, Morris, Davis and Davis, 2003). This construct was developed by merging effort expectancy, perceived ease of use, and complexity from the other models. The third construct, social influence (SI) is the degree to which an individual feels social pressures to use a particular information technology (Ventakesh, Morris, Davis, & Davis, 2003). This construct suggests an individual's behavior is influenced by the way in which one believes important others will view them as a result of using the IT application. This construct is based upon subjective norms found in TRA, TPB, social factors in MPCU and image in IDT (Ventakesh, Morris, Davis, & Davis, 2003; Kijisanayotin, Pannarunothai, & Speedie, 2009). Finally, facilitating

conditions (FC) is the degree to which an individual believes that his or her organization supports and provides the necessary resources for the implementation of technology (Straub, 2009). This construct combines perceived behavioral control from the TPB, facilitating conditions from MPCU, and compatibility from IDT (Venkatesh, Morris, Davis & Davis, 2003). Figure one provides the diagram of the UTAUT model. A matrix providing the definitions is available in appendix A.

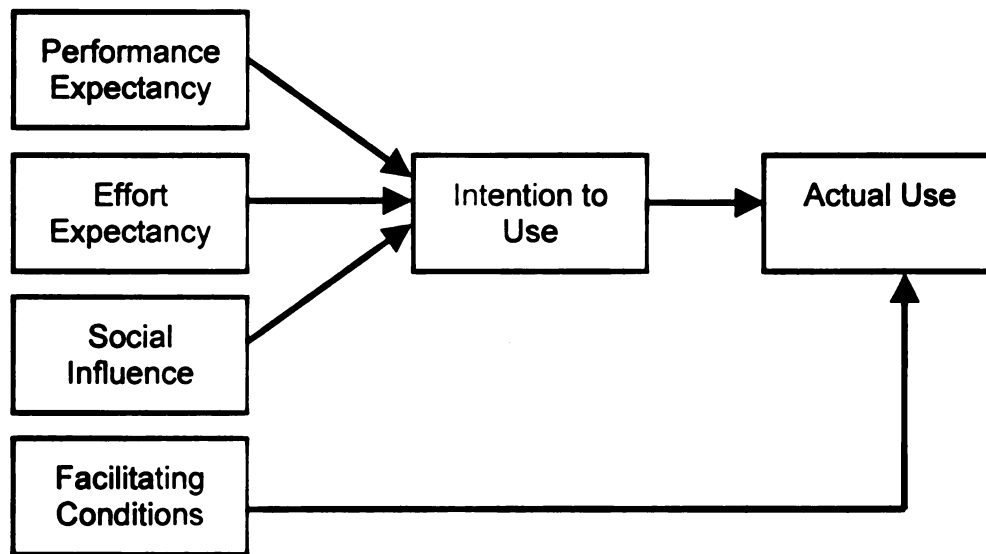


Figure 1: The UTAUT Model (Venkatesh, Morris, Davis & Davis, 2003)

UTAUT in practice

Through the use of the UTAUT model, this paper seeks to identify potential key perceptions of adoption of EMR systems by nurses with the intent of informing future implementations and further extend the UTAUT model. Additionally, an examination of the differences of perceptions among various types of hospital nurses regarding the adoption of EMRs will be conducted. The

utilization of the UTAUT model in this research is a starting point to better understand the importance of social influence and its relationship with other UTAUT constructs.

The UTAUT has been used only a few times within the health care context. Chang and colleagues (2007) examined physician acceptance of a clinical decision support system in Taiwan. The research demonstrated PE was the strongest predictor, which is consistent with other studies using the UTAUT (Ventakesh, Morris, Davis, and Davis, 2003). They also suggest that SI was a weaker predictor than expected and hypothesized that is because most physicians are relatively autonomous, when compared to other professionals (Chang, Hwang, Hung, and Li, 2007). Kijisanayotin and colleagues (2009), also working in Taiwan, used the UTAUT to explain the use of IT in community health centers. The results demonstrated that the UTAUT constructs were substantial and accounted for more than half of the variance in the intention to use IT. Once again, PE was shown to be the strongest factor. Additionally, Siracuse and Sowell (2008) studied the use of personal digital assistants (PDAs) with doctor of pharmacy students (PharmD). This research suggested the UTAUT was able to facilitate the understanding in explaining PharmD students' intent to use PDAs in their work.

Studies applying the UTAUT among nurses are relatively sparse. A study examining the non-acceptance of videophone use by hospice nurses implementing the UTAUT suggest this model is can be used with nurse populations (Whitten, Holtz, Meyer, & Nazione, 2009). It also hinted that the

department (e.g., home hospice) in which the nurses' work could also be a key factor of adoption. Additionally, Wills and colleagues (2008) utilized the UTAUT with registered nurses, nurse practitioners, and physician assistants in a small regional hospital installing an EMR system. Their findings indicate that social influence had the most direct effect on intention, followed by performance expectancy, and effort expectancy. This finding is consistent with the literature, which suggests that women (as the majority of nurses are women) tend to perceive social influence to a higher degree and ease of use to a lower degree (Wills, El-Gayar, & Bennett, 2008; Venkatesh & Morris, 2000). That research established that the UTAUT was able to provide a reasonable explanation of these health professionals' acceptance of the EMR. However, the study sample size was small (n=53) and they did not explore any differences among the nurses such as education level, department, and position. These examples indicate the UTAUT model offers a potential contribution to the study of health care settings and that nurses may perceive the UTAUT constructs differently than other professions, including physicians.

The construct of social influence is emphasized in this research because it has been found to be more salient with women (majority of nurses are women) when introducing new technologies, especially in a mandatory setting this could be key in this research (Venkatesh & Morris, 2000; Wills, El-Gayar, & Bennett, 2008). Social influence can shape the attitudes and behaviors of individuals when they perceive the situation to be uncertain (Salancik & Pfeffer, 1978). Based on past research, social influence rather than performance expectancy

may be the strongest predictor of use intentions in this setting (Wills, El-Gayar, Bennett, 2008; Venkatesh & Morris, 2000). Therefore, hypothesis one has been developed:

H1: Social influence, as defined by the UTAUT model, will explain the most variance of the behavioral intention to use the EMR system by the nurses.

Additionally, other research using the UTAUT suggests that when a system is mandatory, EE will have little impact on the intention to use the system. Due to the mandatory nature of the EMR use at MGH, effort expectancy is not predicted to have an impact on the nurses' behavioral intention to use the EMR system. The second hypothesis was developed to further test this phenomenon in a hospital setting.

H2: Effort expectancy, as defined by the UTAUT model, will explain the lowest variance of the behavioral intention to use the EMR system by the nurses.

Furthermore, previous research suggests that when an individual has greater experience with a task, in this case computer use, the need for social influence is reduced because he or she will reference their own past experiences (Fulk, Schmitz, & Steinfield, 1990). Therefore, hypothesis three was created to address the notion that nurses who are confident in their Paragon skill will not seek out others' perceptions of the EMR system as they feel their past experience with computers will help them navigate this system.

H3: Nurses with high self-reported computer efficacy will score lower on the UTAUT construct of social influence as an intention to use the EMR system.

Although, past studies have demonstrated when individuals do seek advice and social influence is high, they generally turn to a specific group or network for advice (West, Barron, Dowsett, and Newton, 1999). Therefore, understanding the social network could prove to be useful in informing future implementations of technology with regards to nurses.

Overall Technology Adoption Studies

Research regarding the adoption of information communication technologies (ICT) in organizations has been plentiful over the past decades (Burkhardt & Brass, 1990; Daft & Lengel, 1986; DeSantis & Poole, 1994; Garton & Wellman, 1995; Markus, 1994; Orlikowski & Yates, 1994; Short, Williams, & Christie, 1976). These studies have examined several types of ICTs, including email, voicemail, spreadsheets, and groupware (Venkatesh, Davis, and Morris, 2004). Researchers have noted that email and faxes have had different rates of diffusion, and these differences can be attributed to the organizations' culture (Straub, 1994). A variety of antecedents have been proposed as keys to acceptance and adoption of these ICT applications. For instance, using a student sample, Lou and colleagues (2000) examined the perceived need for a critical mass on the adoption of groupware. Their research suggested it was important to have a core group of users, an initial critical mass, in place during the implementation for a successful adoption to occur. Karahanna and Limayem

(2000) also examined the impact of social influence on voicemail and email applications, this study indicated that these technologies are used differently and have different impacts on work through the varying levels of social influence.

While these are some examples of research regarding new ICT adoption in organizations, other research has also demonstrated that context of both the technologies and the organizations are important to the adoption process (Haythornthwaite, 2002). In this instance, EMR are a type of communication technology, but represent an application that has a different purpose than simply communicating between colleagues. Also, many researchers have suggested attitudes of medical professionals in adopting information technology are different than other business professionals (Chau & Hu, 2002; Mathieson, 1991). Therefore it is key to focus specifically on health care providers as well as EMR systems and examine they are adopted and deployed.

Social Networks

The objective of conducting a social network analysis is to detect and understand the patterns of social ties between individuals (DeNooy, Mrvar, & Batagelj, 2005). These ties are important because they can elucidate the path of a group's influence on an individual's behavior and attitudes (Lauman, Mardin, & Presky, 1989, deNooy, Mrvar, & Batagelj, 2005; Ibarra & Andrews, 1993). A social network analysis provides a method for describing these ties among individuals and seeks to explain the social structure of communications (Rogers, 1979, Scott, 2000; deNooy, Mrvar, & Batageli, 2005). While formal structures exist in larger organizations, emergent or informal networks may have a

significant effect on the flow of information, attitudes and behaviors of members of a group (Ibarra & Andrews, 1993; Rogers, 1979). Rogers (1979) also suggests that as a communication structure emerges, behaviors and attitudes can be predicted. Therefore, understanding the social network structure of a group can lead to more effective dissemination of information through the identification of champions and inform implementation design strategies (West, Barron, Dowsett, & Newton, 1999). Champions or opinion leaders have significant effects on the network as they can provide legitimacy to a new idea or change in behavior, provide feedback to managers and other administrative stakeholders, and act as role models for how the behavior change should occur (Valente & Pumpuang, 2007).

Past studies

Many studies using social network analysis in a health setting explore how an individual's social network affects their health behaviors. Some examples include breastfeeding (McLorg & Bryant, 1989), receiving mammograms (Eng, 2006), understanding the spread of obesity (Christakis & Fowler, 2007) and accessing mental health resources (Kawachi & Berkman, 2001). Research has also established the importance of social networks in supporting people with post-traumatic stress disorder (Kozloff, 1987), caregivers of people with dementia (Haley, Levine, Brown, Berry, & Hughes, 1987) and cancer survivors in improving their quality of life (Sapp, Trentham-Dietz, Newcomb, Hampton, Moinpour, & Remington, 2003).

There has been some research conducted utilizing social network analysis that seeks to better understand the structure of social influence and communication ties of medical professionals. In 1966, Coleman and colleagues examined the social network of physicians and how a new drug was diffused throughout the group. They found the physicians with more contacts and who were more central in the network, were early adopters of the new drugs and had stronger influence on others in their adoption of prescribing the new drug. However, Burt (2010) reexamining this data, found that peer-pressure had the weakest effect on physicians' behavior change and instead noted it was more likely that it was their "personal predisposition toward adoption" (p.33). This may be explained because physicians tend to be more autonomous than other professionals, such as lobbyists and managers (Burt, 2010). Also examining the effects of a physician's social network and the influence on the prescriptions they write, Nair and associates (2006) found that the behavior was significantly influenced by the behavior of "opinion leaders" in the physician's reference group, and they were able to capture this data through social network analysis. In addition, Keating and colleagues (2007) explored how physicians obtain information from their colleagues regarding women's health issues. A social network analysis demonstrated that doctors with more experience and expertise in this area were sought after; also information seeking and sharing was based on physicians' schedules and location (Keating, Ayain, Clearly, & Marden, 2007).

Further research on how social networks impact the decision-making in a health context has also been conducted. Cott (1997) demonstrated that the

social structure in medical teams highlighted the difference of position (high-level workers versus low-level workers) in decision-making. Another study compared two primary care practices and was able to demonstrate that the different patterns and structure of decision-making influenced how an organizational change was perceived (Scott et al., 2005).

Other studies have sought to appreciate how different professional roles or team communications are structured. In a study that examined the roles of nurse administrators and physician clinical managers, researchers documented that the information seeking of each group significantly differed. The nurse administrators reached out to a more diverse group of people for information, whereas, physicians tended to seek information and advice from physicians that were higher in the organizational hierarchy (West, Barron, Dowsett, & Newton, 1999). Another study has established that social network analysis was an efficient method to describe the relationships of team members in two teams in a medical intensive care unit. The team treating a stable patient had less communication ties, whereas the team treating an unstable patient had many more ties (Lurie, Fogg, & Dozier, 2009). This suggests that the context of the situation plays an important role in the development of the communication structure.

Social network analysis can illustrate the social ties and links between individuals. This allows researchers to trace the pathways of communication and social influence. There have been few studies examining the social networks of health professions. However, the studies that have been conducted indicate

social influence can impact practice and knowledge. Other studies have demonstrated that the position of the individual and the context of a situation also impacts the emergent social structures. While this research is not performing a rigorous social network analysis, it attempts to utilize those themes to understand how the communication between nurses impacts the adoption of the EMR system. Because of the exploratory nature of this part of the research, several research questions were poised to better understand the social network of nurses in the ICU/CCU at MGH during an EMR implementation.

RQ1: Is there a champion of the EMR system within the intensive care/critical care unit?

RQ1a: Why are those people identified as a champion?

RQ2: What social network characteristics emerged through the implementation process?

RQ2a: Within the ICU/CCU, who was sought after for questions/advice regarding the EMR system? Why were they sought out?

R2b: Are their differences between the shifts? Between the departments?

Summary

As EMR systems are being mandated throughout the United States and becoming more prevalent in other countries, it is important to have a theoretical examination of the adoption process. Especially key in this understanding are the perceptions of nurses, as they are the frontline of care, often a conduit for

patient information to the physician and have more charting responsibilities. These hypotheses and research questions are intended to guide this research in testing the UTAUT model within this population and to uncover the social structures that emerged in regards to the EMR adoption. This work continues with chapter three, discussing the methods used in the execution of this investigation.

III. Methodology

This research examines nurse perceptions of intention to use a newly implemented EMR system (the Paragon system) as understood through the UTAUT model and the overall social structure of the ICU/CCU at MGH regarding this system. In order to address the hypotheses and research questions presented, a mixed methodology design was utilized. Combining both qualitative and quantitative research methods is useful in a health care setting, as this field is full of complexities and a single perspective would not provide a complete understanding of the phenomena being studied (Forhofer, 2003; Clarke & Yaros, 1998; Flemming, 2007; Baum, 1995). For that reason, mixed methodology research and analysis is growing in popularity among social scientists in health (Forhofer, 2003). There are multiple benefits of employing qualitative and quantitative methods for complementary reasons. For instance, this design maximizes the strengths of each method, while minimizing their weaknesses (Bryman, 2006; Greene, Caracelli, and Grahma. 1989). This method can also identify a phenomenon or a perspective that might have gone unnoticed when using a singular approach (Tashakkori and Teddlie, 2003). The mixed methods design in this study sought to capture information about participants' experiences, while also documenting any general organizational trends and contexts.

This chapter begins with a description of the study setting, including the area, the hospital, the intensive care/critical care unit and the EMR application selected for implementation. This is followed by a description of the study

sample for both the survey and the specific unit interviewed. Finally, the data collection and analysis procedures are presented.

Setting

This research took place in Michigan's Upper Peninsula (UP) because it offers a unique research opportunity to study an implementation of an EMR system in a rural area. The UP accounts for one-third of the land area of Michigan (16,452 sq. miles); however, its population is less than three percent (312,553) of the total population of the state.

Rural areas

Reports indicate that residents in rural counties have less education than those living in metropolitan areas. In 2000, 19.3 percent of the rural population had not completed a high school education compared to 16.5 percent and 15.5 percent of the metropolitan and micropolitan population in Michigan, respectively (Wightman, Horste, Speckman-Randall, Stratton, and Barnett, 2008). People living in rural areas also have higher percentages of poverty and unemployment. Urban and rural causes of death are similar, but the rural population has a higher prevalence of deaths caused by heart disease, cancer, and stroke (Probst, Laditka, Moore, Harun, and Powell, 2005). In addition, rural Michigan faces a shortage of health care providers at all professional levels, which is getting worse as more providers retire (Wightman, Horste, Speckman-Randall, Stratton, and Barnett, 2008). To summarize, the rural population, especially in the UP, confronts significant demographic challenges such as a larger older population,

less education, high poverty rates, being sicker, and limited access to health care because of long travel distances and a shortage of providers.

Marquette General Hospital

Marquette General Hospital (MGH) is a 315-bed regional referral facility that serves the Upper Peninsula (UP) of Michigan. MGH has Center of Excellence Status for bariatric surgery, cardiovascular services, oncology, rehabilitation, neurology/neurosurgery, behavioral health and women's and children's services. These are among the 64 specialty services available from the health system. Annual inpatient visits to the hospital exceed 12,000 and there are approximately 350,000 outpatient visits. Currently, MGH employs an estimated 3000 people and 200 medical staff to care for the needs of the residents of Marquette County (MGH, 2009).

There are 26 units at MGH that have nursing staff members. Specifically, the ICU/CCU at MGH has one nurse clinical director, three nurse managers, one nurse educator (who is also a nurse manager), approximately 77 registered nurses, 12 LPNs and 12 unit clerks. The units have a 25 bed-capacity and have staff members working 24 hours a day on three shifts. The morning shift (first shift) is from 7am to 3pm, the afternoon shift (second shift) is 3pm to 11pm, and the night shift (third shift) is 11pm to 7am. This unit conducts daily nurse-led patient-rounds during the first shift. The patients of the ICU/CCU are suffering from all illness types and depending on the nature of the patient illness and the level of severity, the nurses monitor the vital signs and "drips" (continuous infusion of medications) at different intervals (spanning from every three minutes

to every hour). The ICU/CCU at MGH can be characterized as “controlled chaos” as the health care providers are effortlessly moving on from one patient situation to another in providing quality patient care (Kelleher, 1982).

McKesson's Paragon

After many years of planning and a hospital management change, MGH chose to implement McKesson's Paragon Order Management (Paragon) system as the electronic medical record for its patients. McKesson is America's leading health care IT corporation with software applications and hardware in more than 70 percent of the nation's hospitals that have 200 beds or more (McKesson, 2009). For several years MGH used an application called Precision 2000 (P2000). This was a McKesson system and it did most of the administrative functions needed to run the hospital, but did not provide any clinical documentation functions. It had patient registration, fixed assets, accounts payable, accounts receivable, general ledger/accounting, patient accounting/business office, purchasing, inventory management, and payroll functions.

P2000 was sunset by McKesson and MGH had to transition to another product. As a replacement to the P2000 a variety of vendors were considered and Paragon (McKesson) was determined to be the best fit. The go-live for the transition from the P2000 to Paragon for non-clinical applications was October of 2008. Additionally, the hospital hoped to add clinical documentation applications to their system. In the words of those at MGH (2009) “Paragon will provide one centralized application to place and receive (doctors') orders, place charges, and

look up results. The new software will be used to place orders for lab, imaging, cardiographic services, dietary, social work, and other areas.”

Due to the of the breadth of Paragon applications that were already on site, implementing anything other than Paragon was not reasonable to the administrators of MGH. Although other systems were available the result would be have been piecemeal with data in different department silos. See figures two (login screen) and three (structure data entry for respiratory items) for screenshots of the Paragon application (additional screenshots can be found in appendix B.)

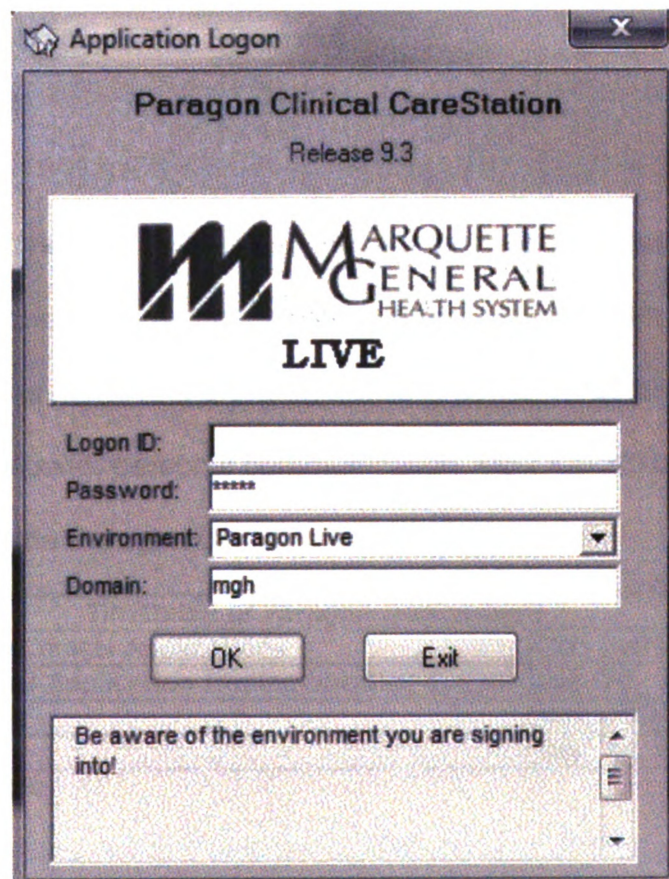


Figure 2: Paragon Clinical Login Screen

EENT ☒ NEURO ☒ NEURO 2 ☒ **RESP** ☐ CARDIO ☐ HEMODY ☐ IV ☐ GASTRO ☐ DENTO ☐ INTEG ☐ INTEG2 ☐ LESION ☐ ADL's ☐ MOBILITY ☐ SAFE ☐ PSYCHSOC ☐ EDUC ☐ NH ☐ SPALLLOW ☐ WITHDRAWAL ☐ SUICIDE RISK ☐

Entry For Dates 05/12/2010 14:17

Assessment Review(s)

☐ PNE

Airway

☐ Patent

☐ ETT

☐ Tracheostomy

☐ Other

Tracheostomy

☐ Stoma Clean/Intact

☐ Signs and Symptoms of Infection

☐ Other

Breath Sounds Anterior L

☐ Clear

☐ Coarse

☐ Rhonchi

☐ Rales

☐ Crackles

☐ Diminished Bases

☐ Diminished Throughout

☐ Wheezing

☐ Stridor

☐ Chest Tube Rub

☐ Absent

☐ Other

Breath Sounds Anterior R

☐ Clear

☐ Coarse

☐ Rhonchi

☐ Rales

☐ Crackles

☐ Diminished Bases

☐ Diminished Throughout

☐ Wheezing

☐ Stridor

☐ Chest Tube Rub

☐ Absent

☐ Other

Suctioning

☐ Oral

☐ Nasal

☐ Oropharyngeal

☐ Endotracheal Tube

☐ Tracheal

☐ Yankauer

☐ Bulb

☐ Suction Catheter

☐ Inline

☐ Used Sterile Technique

☐ Tolerated Well

☐ Other

Chest Tube

☐ Medial/Int

☐ Pleural

☐ Left Side

☐ Right Side

☐ Suction (20 cm)

☐ Suction (40 cm)

☐ Clamped

☐ To Gravity Drainage

☐ Crepitus

Respirations

☐ Regular

☐ Irregular

☐ Labored

☐ Unlabored

☐ Trachypnea

☐ Bradypnea

☐ Apnea

☐ Shallow

☐ Retracting

☐ Dyspnea w/ Exertion

☐ Dyspnea at Rest

☐ Orthopnea

☐ Cheyne-Stokes

☐ Ventilator Controlled

☐ CPAP/BPAP

☐ Other

MOB -- 36 Degrees

☐ Yes

☐ No

Coughing

☐ Dry

☐ Wet

☐ Occasionally

☐ Frequent

☐ Non-Productive

☐ Productive

Retracting

☐ Intercostal

☐ Substernal

☐ Suprasternal

☐ Cervical

☐ Other

Breath Sounds Posterior L

☐ Clear

☐ Coarse

☐ Rhonchi

☐ Rales

☐ Crackles

☐ Diminished

☐ Wheezing

☐ Stridor

☐ Chest Tube Rub

☐ Absent

☐ Other

Breath Sounds Posterior R

☐ Clear

☐ Coarse

☐ Rhonchi

☐ Rales

☐ Crackles

☐ Diminished

☐ Wheezing

☐ Stridor

☐ Chest Tube Rub

☐ Absent

☐ Other

Secretions

☐ None

☐ Scant

☐ Moderate

☐ Copious

☐ Thin

☐ Thick

☐ Clear

☐ White

☐ Yellow

☐ Brown

☐ Green

☐ Bloody

☐ Foully

☐ Other

Chest Tube Air Leak

☐ No

Chest Tube Secretions

☐ None

☐ Bloody

☐ Serousanguineous

☐ Serous

☐ Purulent

☐ Other

Other Assessment Findings

Figure 3: Paragon Structured Data Screenshot

Modular systems like Paragon have a tremendous advantage as they are built to be integrated. An example is the entry of allergy information; the data are entered once by a nurse and are automatically available for pharmacy use (or vice versa) (R. Young, personal communication, May 12, 2010). See table 1 for the timetable of the Paragon deployment at MGH.

Timetable of Paragon Deployment	
Go-Live for Non-Clinical Applications	Oct. 2008
Kick-off of Clinical Application Implementation & EMR	Jan. 28, 2009
Training Sessions	Nov. 2009 - Jan. 2010
Go-Live	Jan. 24, 2010

Table 1: Timetable

Initially, this application has only been rolled-out in MGH's hospital. MGH's clinics have been scheduled to implement the system in a time-phased manner over the next several years.

While the overall training and “go-live” date for the Paragon application was the same hospital wide, there was some variation in the process of the implementation in each unit (see appendix C for the training notification). The ICU/CCU has a nurse educator who is also a nurse manager. The hospital identified and invited him to be a build team member (to work with IT and McKesson in tailoring the ICU/CCU application). He was considered to be the primary super user for the critical care areas. Super users (SU), those that would be a primary help contact were identified in all units. Specifically for the ICU/CCU, 20 (approximately 20%) super users were identified at the beginning of the project planning. At “go-live” there were approximately 12-14 people who functioned in that role during the implementation. For the first week after “go-live” there were two SUs assigned to each shift and these SUs had no patient assignments but were simply there to help other nurses with the Paragon charting. The second week there was one identified super user (no patient assignment) on each shift. While the unit staff still knows who the SUs are, they now have patient assignments. The clinical director of the ICU/CCU supported and budgeted for this expense (personal communication, P. Stuart, April 1, 2010).

Summary

As much of America is classified as rural and is dealing with a health care provider shortage, understanding the characteristics of an EMR system adoption from this perspective may assist in developing future implementations and research endeavors. MGH, a rural regional hospital, has implemented McKesson's Paragon system as their EMR. Examining this EMR implementation from this rural hospital setting and specifically the ICU/CCU may also provide a better understanding of how the EMR system impacts the adoption and emergent social networks of nurses from this rural area.

Sample

There are two sample groups for this research. All of the participants were either RNs or LPNs who provide direct patient care at MGH. The first sample consisted of all RNs and LPNs from MGH that participated in the online survey portion of this research. The second sample of nurses who participated in the research interviews were from MGH's ICU/CCU.

Data Collection & Recruitment

All nurses underwent four four-hour Paragon training sessions over a three-month period (November 2009 through January 2010) until the "Go-Live" date (January 24, 2010). At the individual's final training session, they were asked by the trainer to remain on their computers and complete the online survey for this study using the WebSurveyor application. There was an icon placed on

the desktop, which took the participants directly to the survey. They were notified that participation in this study is voluntary and their data will remain confidential.

Once the training sessions were completed, initial data were analyzed. The social network portion of the survey was not fully completed by the participants as expected. In further discussion with the IT contact person from MGH, an in-depth examination into one department was thought to be the most useful and appropriate method in seeking to better understand how social network characteristics impacted an EMR adoption. The ICU/CCU was selected as it has the most number of nurses in a unit, was the department with the highest response rate on the survey and represented a critical mass of EMR use in the hospital. This method was approved by the hospital and the ICU/CCU. The ICU/CCU nurse educator informed the nurse managers and the staff nurses of the interviews. Interviews took place during all three shifts of the department. The nurses were asked face-to-face by the researcher if they would like to participate in the study. If they agreed they were provided a consent form and asked permission to record the interviews. Interviews were conducted in a private room within the unit during all three shifts and took between five and thirty minutes. Some of the interviews were interrupted due to patient requirements. The interview guide was developed through initial analysis of data in order to better understand some trends and to appreciate the overall structure of the social network of the unit in regards to the Paragon system. The allowable length of the interview guide was negotiated with the ICU/CCU nurse educator. The research proposed having a roster of department names, but this was deemed

unacceptable by the nurse educator as the nurse participants would have to be away from their patients and duties for too long.

Survey

The survey instrument had four sections; the first was a slightly modified UTAUT instrument, the second was a computer efficacy measure, the third asked demographic information, and the last section included the social network analysis questions.

UTAUT Instrument

The UTAUT instrument modifications include the identification of the Paragon application as the IT application and MGH as the organization. This section of the survey was comprised of 37 items, measuring performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intention to use. The UTAUT model has been demonstrated to explain almost 70 percent of the variance of IT usage in a longitudinal study. When the measure was first constructed, 48 separate validity tests were run to determine convergent and divergent validity. Loading patterns were acceptable, with a majority at 0.70 or higher. The UTAUT instrument has also been empirically validated among four businesses in various industries (not including the health care), and cross-validated using data from two other businesses.

Computer Self-Efficacy Instrument

The computer self-efficacy measure (Compeau & Higgins, 1995) was also slightly modified to identify the Paragon system as the IT application. This section

of the survey was comprised of ten items. Computer self-efficacy as defined by Compeau and Higgins (1995) “refers to a judgment of one’s capability to use a computer” (p.192). The measure has been tested for internal consistency and all measures exceed 0.80. The factor analysis was acceptable with all items exceeding 0.70, except in eight cases (out of 48 items).

Demographic Information

The survey asked participants seven demographic items. These items included gender, age, and educational background. They were also asked specific nursing questions such as how long they have been a nurse, how long they have been employed at MGH, their department and title.

Social Network Instrument

The social network of the MGH nurses was attempted to be determined through asking participants on the online survey to name people who are important sources of information regarding the Paragon application. The subjects were also asked to provide their information sources’ name, position, department and method of communication. The most common strategy in the study of social networks is to identify all the members of a particular group and ask them to report who they turn to for information or advice allowing researchers to trace the various connections among individuals (Scott, 2000, Wong, 2008, Sparrow et al, 2001; Creswick & Westbrook , 2007; Keating, Ayanian, Clearly, & Marsden, 2007; Nair, Manchanda, & Bhatia, 2006; Lurie, Fogg, & Dozier, 2009; Cott, 1997; Coleman et al., 1966; Rogers, 1979). Social network scholars have

demonstrated this is a valid method of determining a person's social network (Krackhardt, 1990; Ibarra & Andrews, 1993; Rice 1993). This method of data collection has roots from one of the earliest social network analysis studies by Moreno (1934). This survey measure utilized a free recall method for identification of information sources, with no restriction of choice, which increases the reliability of the measure (deNooy, Mrvar, and Batageli, 2005). Unfortunately, the response rate and accuracy for this portion of the survey was low. The complete survey instrument is located in appendix D.

Interviews

Initially, the interviews were going to be conducted with up to 50 randomly selected nurses who completed the online survey. However, many (76%) of the participants did not fill in their name or department correctly, leaving it next to impossible to select nurses in that manner. For instance, the participants would not put in their full name, used initials, or would not say what department they were from. Furthermore, when asked with whom they spoke to regarding the Paragon system, many did not write a person's name down or stated things like "some people." The MGH IT contact person suggested that the ICU/CCU would be open to conducting interviews and had the largest unit response rate on the survey. The interview guide was modified for this type of sampling and sought to capture the social characteristics of EMR adoption unique to the nursing profession. The analyses of the survey results were used to develop the final interview guide. This study utilized a semi-structured face-to-face interview protocol, allowing the researcher to explore the social and organizational context.

This method's greatest strength is its validity, as researchers can conclude they are measuring what they intend to with assurance (Mason, 2002). The interview guide questions are located in appendix E.

Data Analysis

Survey data were first analyzed using descriptive statistics to understand the overall characteristics of the participants. The fit of the model was assessed through regression analysis and a correlation matrix. Means comparison testing between the demographic characteristics and the UTAUT were also conducted. The statistical software package that was used to analyze this data was SPSS (version 18).

To analyze the interview data, broad code categories were developed based off of the UTAUT model and the social network data and served as a preliminary sorting tool. The researcher used thematic analysis and created a list of common perceptions. Then intercoder reliability was established, as it is important to show that the coders are coding the data the same way. Once a scheme was developed, two coders coded ten randomly selected interviews of the interviews in order to establish reliability. First, the coders reached unitizing reliability for all variables. This was done by calculating percent agreement, due to the small sample of cases and the little variability in numbers of units, as most of the responses were short. The percent agreement for unitizing each variable was over 90 percent. Then, coding of the variables proceeded until reliability was reached for all variables ($\kappa \geq 0.8$) with necessary refinements made to the coding scheme during the process. The categories were not mutually exclusive and one

respondent could have multiple answers, leading to the possibility that a response could have over 100 percent. Once reliability was established, coders came together to reconcile any disagreements. Once the reliability of the coding scheme reached a Cohen's Kappa of at least 0.80, the remaining interviews were then coded. A Cohen's Kappa of at least 0.80 has been deemed acceptable in much of the literature (Neuendorf, 2000; Riffe, Lacy and Fico, 2005).

Summary

Mixed methodology research is as appropriate way to examine the intended adoption by nurses of EMR. Combining both qualitative and quantitative research methods is valuable when studying a health care setting. Utilizing this type of research design allows for maximizing the strengths and minimizing of the weaknesses of each method. This has been demonstrated as a reliable method allowing for meaningful conclusions to be made. This particular study was conducted at MGH with nurses during the implementation of an EMR system. This research utilized an online survey and face-to-face interviews with MGH's ICU/CCU nurses. The next chapter continues with the presentation of the results.

IV. Results

This chapter provides the results of this study in three sections. The first section provides subject demographic information in two parts. The first part reflects the demographics of the survey participants and the second part is the demographic information from the interview participants. The second section of the chapter provides the results from the survey. The third section, presents results from the interviews in order to answer the research questions regarding the social network of the ICU/CCU. While the interviews were meant to address the research questions, some quotes are used to further clarify some survey responses. The chapter concludes with a summary of the results, which is followed by a discussion of this study.

Demographic data

This section is divided into two parts. The first reports the demographic data of the subjects that took the online survey. The second part provides the demographic data of the ICU/CCU nurses that took part in the interviews.

Survey demographics

The first sample included nurses (n=113) who took the online survey during their last training session for the Paragon system. In all of MGH there are approximately 558 full and part-time nurses (response rate=21%). Ninety-two percent of the sample were women. Just over two-thirds of the population were younger than 40 years old (20 to 29 years old=38.9%; 30 to 39 years old=29.2%). Those who were forty to forty-nine accounted for 18.6 percent of the

sample, with 13.3 percent of the respondent reporting that they were 50 years old or older. The average age was 30-39 years old. The number of years these individuals had been nursing varied from less than one year (6.2%) to more than twenty years (15.9%). However, the majority of the subjects reported that they had been nursing for one to four years (31.9%), five to nine years (23%), ten to fourteen years (14.2%) or fifteen to nineteen years (8.8%). The number of years these professionals have been working at MGH also varied from less than one year (9.8%) to more than twenty years (9.8%), with most having been employed at MGH for one to four years (29.2%), five to nine years (30.4%), ten to fourteen years (15.2%) and fifteen to nineteen years (5.4%). Over half of the sample population had acquired at least a bachelor degree or has had received some bachelor degree credits (65.1%), approximately a quarter of the sample had an associates degree (27.5%), and a small number had completed some master-level credits or received a mater degree (7.4%). See table two for a description of the survey sample.

MGH Overall (n=113)						
Gender	Women	Men				
	92%	8%				
Age	20-29 Years	30-39 Years	40-49 Years	50-59 Years	60+ Years	
	38.9%	29.2%	18.6%	11.5%	1.8%	
Years Nursing	Less than 1	1-4 Years	5-9 Years	10-14 Years	15-19 Years	20+ Years
	6.2%	31.9%	23%	14.2%	8.8%	15.9%
Years at MGH	Less than 1	1-4 Years	5-9 Years	10-14 Years	15-19 Years	20+ Years
	9.8%	29.2%	30.4%	15.2%	5.4%	9.8%
Education Level	Assoc. Degree	Some Bachelor Credits	Bachelor Degree	Some Master Credits	Masters Degree	
	27.5%	5.5%	59.6%	4.6%	2.8%	

Table 2: Survey Participants' Demographic Characteristics

Interview Demographics

The second sample of this study which participated in the second phase of data collection (interviews) were nurses from the ICU/CCU. This unit had the largest pool of nurses at MGH with 92 nurses (RNs and LPNs). The response rate from this unit was the highest from the online survey (30 reported participants, 26%). From the ICU/CCU there were 31 interview participants (response rate=33%), of which 24 (77.4%) were women and seven (22.5%) were men. Those who agreed to the interview included two nurse managers, two LPNs, and 27 RNs, all of who provide direct patient care. The age range of the nurses on the unit was 22 to 64 years old; the average age was 39 years old. All of these nurses are required to do all of their patient charting on the McKesson Paragon System. In the end, at least 12 nurses (those that provided both their name and department) participated in both the online survey and the interviews.

Survey results

This section of the chapter provides the results from the survey data that test the hypotheses that were presented in chapter three. The findings from the UTAUT, specifically social influence, performance expectancy and effort expectancy are described. A description of the findings from the computer efficacy scale is also provided.

UTAUT Instrument

The UTAUT scale was checked for reliability using Cronbach's Alpha (Cronbach, 1951) and obtained $\alpha=0.91$. George and Mallery (2003) state and

alpha coefficient above 0.70 is acceptable when calculating internal consistency. Also in this study, the UTAUT was able to account for 64 percent of variance in intention to use the Paragon system. Additionally, the dependent variable, behavioral intention was tested for reliability and obtained a Cronbach's alpha of $\alpha=0.76$. All of the constructs significantly correlated with each other. Table three provides a correlation matrix of the UTAUT constructs and table four provides the regression analysis of the UTAUT model. See figure four for data regarding the UTAUT model. A factor analysis was also conducted, using the four categories of the UTAUT (see Appendix F). Many items were removed from the scale as a result of the factor analysis and the individual scale reliability and the regression was based off of these. Those items removed are noted later in the document. Facilitating conditions was not included in the factor analysis or the regression as its construct is intended to predict actual use and not intended use. During the time that the survey was conducted, the nurses had not yet had the opportunity to use the Paragon system in their daily work routines.

UTAUT Correlations					
	PE	EE	SI	FI	BI
PE					
Pearson Corr.	1	0.60**	0.44**	0.50**	0.48**
Sig (2-tailed)		0.00	0.00	0.00	0.00
EE					
Pearson Corr.	0.60**	1	0.54**	0.67**	0.46**
Sig (2-tailed)	0.00		0.00	0.00	0.00
SI					
Pearson Corr.	0.44**	0.54**	1	0.36**	0.55**
Sig (2-tailed)	0.00	0.00		0.00	0.00
FI					
Pearson Corr.	0.50**	0.67**	0.36**	1	0.44**
Sig (2-tailed)	0.00	0.00	0.00		0.00
BI					
Pearson Corr.	0.48**	0.46**	0.55**	0.44**	1
Sig (2-tailed)	0.00	0.00	0.00	0.00	

**Correlation is significant at the 0.01 level (2-tailed)

Table 3: UTAUT Correlations

Model Summary					
R	R ²	Adjusted R ²	Std. Err.		
0.53	0.28	0.26	0.57		
Construct	β	Std. Err.	t	Sig.	α
PE	0.17	0.09	1.94	0.05	0.82
EE	0.15	0.09	0.18	0.11	0.87
SI	0.32	0.12	2.60	0.01	0.87
Dependent Variable: Behavioral Intention					

Table 4: Regression Model

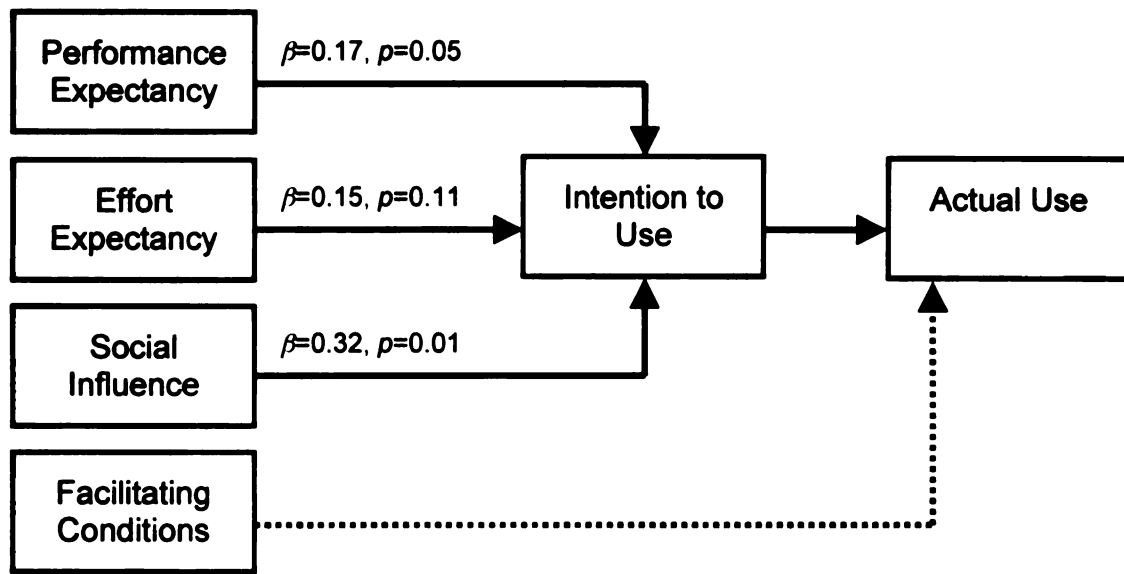


Figure 4: The UTAUT Model Findings

The next sections will explore each of these constructs, how they relate to the demographic characteristics of the nurses and test the hypotheses presented, beginning with hypothesis one and the strength of social influence.

Social Influence

The first hypothesis examined the impacts of social influence as defined by the UTAUT model. The social influence measure was tested for reliability and scored a Cronbach's alpha of $\alpha=0.87$. The data also demonstrated no significant differences between those under 40 years old ($M=3.50$, $SD=0.54$) and those older ($M=3.58$, $SD=0.50$), $t(111)=0.73$, $p=0.74$, two-tailed; those with at least a bachelors degree ($M=3.52$, $SD=0.50$) and those with more education ($M=3.50$, $SD=0.52$), $t(107)=-.021$, $p=0.83$, two-tailed; those who have been a nurse for more than 15 years ($M=3.53$, $SD=0.56$) and those who have been working for

fewer than 15 years ($M=3.52$, $SD=0.51$), $t(111)=-0.02$, $p=0.98$, two-tailed, as a nurse; or time at MGH, less than ten years ($M=3.53$, $SD=0.48$), compared to ten or more ($M=3.53$, $SD=0.55$), $t(110)=0.42$, $p=0.98$, two-tailed, as it related to social influence. The items that demonstrated the strongest perceived social influence were related to support from the overall management ($M=4.30$, $SD=0.68$) and the overall hospital ($M=3.95$, $SD=0.78$). The subjects perceived the influence of the doctors in using the Paragon ($M=3.16$, $SD=0.77$) and senior management of MGH ($M=3.18$, $SD=1.09$) to be the lowest sources of social influence. Table five provides the descriptive statistics of each social influence item. Regarding perceived support of physicians and upper management, one of the nurses from the ICU/CCU specifically commented on physician and upper management involvement in the Paragon deployment:

It [EMR deployment] really should have physician management first because most of the functions would follow in-line with the physician order and electronic medical records. But for whatever reason they [physicians] opted out of this system and were allowed in that option.... The double standards are so blatantly obvious to the nursing staff that it is just causing a rift and it is also causing a lack of confidence in the administration for not having more control over the physician group. – R31

There were no faces put to the program from upper administration, we never really saw the people from above being involved with the staff members and being a part of the process. It was mandated from above and that was it...It was definitely noticed by the staff. – R31

SI Items		
Item	Mean	Std. Deviation
Nurses in my department think that I should use the Paragon application.	3.41	0.89
Other nurses in Marquette General Hospital think that I should use the Paragon application.	3.47	0.86
Doctors in Marquette General Hospital think that I should use the Paragon application.	3.16	0.77
The management of Marquette General Hospital thinks that I should use the Paragon.*	4.30	0.68
People who influence my behavior think that I should use the Paragon application.	3.43	0.83
People who are important to me think that I should use the Paragon application.	3.37	0.82
The senior management of Marquette General Hospital has been helpful in the use of the Paragon application.*	3.18	1.09
In general, Marquette General Hospital has supported the use of the Paragon application.*	3.95	0.78

* Item not used in regression analysis

Table 5: SI item descriptive statistics

Using the social construct scale, hypothesis one predicted that social influence as defined by the UTAUT would account for the most variance in the intention to use the Paragon System by the nurses. The survey responses indicated this was true ($\beta=0.38$, $p<0.001$).

Much of the past research has indicated that performance expectancy is the highest predictor of intention to use a technology. The following section will further explore this construct in regards to this population.

Performance Expectancy

Exploring performance expectancy in the MGH nurse population. The items for this construct obtained a Cronbach's alpha reliability of $\alpha=0.82$. Performance expectancy was significantly different between those nurses who have been at MGH for less than ten years ($M=3.02$, $SD=0.11$) and those who worked at MGH for more than ten years ($M=2.72$, $SD=0.66$, $t(110)=-2.32$, $p=0.02$, two-tailed. Suggesting that nurses who were newer to MGH felt that the Paragon system would help them perform their tasks more efficiently than nurses who had been at MGH for longer. This could indicate that once a nurse has been working at a facility for ten years or more they may be institutionalized in past processes. Age also seemed to trend towards being a significant difference as those who were under 40 years old ($M=2.92$, $SD=0.74$) tended to have higher perceptions of performance expectancy than those who were 40 years old and older ($M=2.65$, $SD=0.58$), $t(111)=-1.89$, $p=0.06$, two-tailed. While those with at least a bachelor degree ($M=2.99$, $SD=0.71$) and those with more education ($M=2.67$, $SD=0.61$), $t(107)=-1.56$, $p=0.12$, two-tailed, and those who have been a nurse for 15 years or more ($M=2.67$, $SD=0.61$) compared to those who have been a nurse for less time ($M=2.89$, $SD=0.72$), $t(111)=-1.15$, $p=0.15$, two-tailed, were not significantly different. The item that was perceived to be the overall strongest in regards to performance expectancy concerned Paragon's usefulness ($M=3.98$, $SD=0.79$).

The weakest item was related to receiving a promotion for using the Paragon system ($M=1.80$, $SD=0.98$). See table six to see the descriptive statics for each item measuring performance expectancy.

PE Items		
Item	Mean	Std. Deviation
I would find the Paragon application useful in my job.	3.98	0.79
Using the Paragon application will enables me to accomplish tasks more quickly.	3.29	1.01
Using the Paragon application will increase my productivity.	3.24	0.95
If I use the Paragon application, I will increase my chances of getting a raise.*	1.81	0.98
If I use the Paragon application, I will increase my chances of getting a promotion.*	1.80	0.98

* Item not used in regression analysis

Table 6: PE item descriptive statistics

The results showed that the perceptions of performance expectancy as defined by the UTAUT were a significant indicator of behavioral intention by nurses, but not the strongest. The survey data also indicated this was true ($\beta=0.25$, $p=0.01$).

The next section explores the second hypothesis and the strength of effort expectancy within the MGH nursing population.

Effort Expectancy

The second hypothesis sought to further understand nurses' perceptions of effort expectancy. The items for this construct obtained a Cronbach's alpha

reliability of $\alpha=0.59$. After performing a factor analysis on the measurement items, the two reverse coded items were removed and the resulting Cronbach's alpha was $\alpha=0.82$. Effort expectancy was not significantly different between those nurses that were younger than 40 ($M=3.43$, $SD=0.47$) and those that were 40 years old or older ($M=3.30$, $SD=0.53$), $t(111)=-1.37$, $p=0.18$, two-tailed. Furthermore, there was no significant difference in educational level, those with at least a bachelors degree ($M=3.50$, $SD=0.47$) and those with more education ($M=3.32$, $SD=0.50$), $t(107)=-1.73$, $p=0.08$, two-tailed. However, nurses who have been a nurse for less than 15 years ($M=3.44$, $SD=0.45$) felt that the Paragon system would be easy to learn and use, compared to those who have been a nurse for more than 15 years ($M=3.21$, $SD=0.57$), $t(111)=-2.21$, $p=0.03$, two-tailed. Also, nurses who have been working at MGH for more than ten years ($M=3.31$, $SD=0.52$) found the Paragon system to be more difficult to learn and use compared to those who have been at MGH for less than ten years ($M=3.51$, $SD=0.42$), $t(110)=-2.15$, $p=0.03$, two-tailed. Suggesting that those who have been nurses for less time and been employed fewer years at MGH have less experience regarding the previous charting processes. The items that were perceived to be the strongest among the effort expectancy construct items were related to the understanding of how much effort that would be needed to use the system ($M=4.07$ $SD=0.61$). The weakest item on this scale was the perception that the Paragon system would be easy to use ($M=3.30$, $SD=0.98$). Table seven provides the descriptive statistics for all of the effort expectancy items.

EE Items		
	Mean	Std. Deviation
I understand how much effort I will have to expend to use the Paragon application.	4.07	0.61
I would be able to understand how to accomplish my tasks using the Paragon application.	3.60	0.78
It would be easy for me to become skillful at using the Paragon application	3.65	0.98
I would find the Paragon application system easy to use.	3.30	0.98
Learning to operate the Paragon application is easy for me.	3.46	1.01

Table 7: EE item descriptive statistics

Hypothesis three speculated that because the use of the Paragon system was mandatory by MGH for nurses to chart patient data, effort expectancy as defined by the UTAUT model would be the weakest predictor of intention to use the Paragon EMR system. The survey results were consistent with this prediction ($\beta=0.10$, $p=0.32$).

As perceptions of Paragon self-efficacy by the nurses was thought to be a predictor in the adoption tendencies of nurses, the following section tests the third hypothesis.

Paragon self-efficacy

Hypothesis three posited that those nurses with higher self-reported computer efficacy would score lower on the social influence as an intention to use the Paragon system EMR. Modifications to the scale were made to recognize self-efficacy perceptions of the Paragon system. The modified efficacy scale used was found to be reliable ($\alpha=0.87$). The survey results indicated this

hypothesis was not supported ($\beta=0.15$, $p=0.31$). However, computer self-efficacy was positively correlated with the UTAUT's social influence construct ($r=0.44$, $p<0.01$). This indicated that the higher the perceived computer self-efficacy the more likely the nurses were to feel the influence of others to be important regarding their intention to use the Paragon system. Also, through interviewing the ICU nurses, there also appeared to be a link in perceiving younger people with having higher computer efficacy. To confirm this, a correlation was conducted between the survey respondents' age and their perceived computer self-efficacy. The correlation was significant ($r=-.019$, $p=0.05$), indicating that the younger nurses had higher perceived computer efficacy than older nurses. Twenty-six percent of the interview respondents when asked about what skills they had that would entice others to seek them out for Paragon help, specifically gave age as an answer. Some examples of this include:

You know, I work with more 'seasoned' nurses, I'll help them find things [on the computer]. -- R2

I have grown up with computers and I think it is a lot harder for the people, generations behind to get accustomed to it because they didn't grow up with computers. -- R6

We have a lot of older nurses that aren't that strong in computer and stuff and those seem to be the ones that have the most questions. -- R9

You know the younger people who have grown up with computers... -- R16

I don't know, maybe it is because I am younger and they assume I know a lot about computers, I mean I do know about computers. -- R21

Interview results

This section provides the analysis of the interviews used to answer the research questions.

Social network characteristics

Research question one asked about champions for the Paragon system in the ICU/CCU department. Seventy-one percent ($n=22$) identified someone from their department as a champion. A higher percentage of nurses from the first and second shift stated that there was a unit champion of the Paragon System, 85 percent of first shift and 100 percent of second shift listed one or more champions. However, only 31 percent of the nurses on third shift stated there was a unit champion of the Paragon system. The frequency of a champion being identified from the first shift compared to the identification of a champion by the nurses from the third shift was submitted to a matched pairs t-test. The frequency of a champion being identified by the first shift ($M= 0.85$, $SD=0.38$) was significantly larger than the frequency of a champion being identified by the third shift ($M=0.31$, $SD=0.48$), $t(12)= 2.94$, $p=0.01$, two tailed. The number of champions was also measured, the first shift nurses on average named 1.62 ($SD=1.19$, range 0-4) individuals as a champion, second shift named 1.20 ($SD=.45$, range 1-2) individuals as a champion, and third shift named 0.31 ($SD=0.48$, range=0-1) individuals as champions. Over all of the shifts, the average number of champions identified was one ($SD=1.03$, range=0-4).

The second part of research question one asked about what characteristics made that person a champion. All of the champions identified by

the interview respondents were either a super user or was the primary-super user. Fifty-five percent indicated a champion to be a super user(s) and 72 percent stated it was the primary-super user. Some examples of what the participants said about why the individual was a champion, include:

[The primary-super user] definitely, just because he was the designer and if there is a problem, he is the one to get it fixed for us. If there are glitches he's able to show [us] why.
— R1

Yeah, I would say [the primary-super user]...He was involved in the building, encourages us to all keep an open mind, listened to us, followed up on the things that we brought to him, got back to us with feedback. — R14

More specifically, the reasons that emerged of why certain individuals were thought of as champions include: that they designed/built the system with IT (55%), it was their job (34%), were good trainers (21%), they spent time with the system (17%), were good at using the system (7%), and involved the unit in getting feedback (7%).

Also, an individual who was classified as a super user or a champion of the system also seemed to have a salient effect on those seeking information about the Paragon system. For example, there was one super user (R14), who was frequently named as a champion and a person frequently turned to when there was a question regarding the Paragon system. Many of the respondents, especially those who had named R14 used similar terms to describe some of their problems with the Paragon system. This particular super user stated in an interview,

I went online and researched the system and the company a little bit when I got frustrated [with the

Paragon system]. I was trying to figure out why they picked out this system. What I read, was greater than ten years ago, that it was a great thing, the best thing [EMR] out there and it is still good for a small facility that doesn't have that much money to spend on an EMR. – R14

Examining the interviews, 55 percent of the respondents who indicated that R14 was a person they looked to, remarked that they felt the system was outdated, cheap and for smaller hospitals, while 10 percent of the respondents who did not go to R14 used these terms in the interviews.

Research question two asked about the overall social network characteristics that were found in this setting. First, through examining the survey data, 75 percent of the subjects ($n=85$) indicated that they have spoke to someone regarding the Paragon system. Ninety-eight percent of those contacted worked at MGH. When asked about the shift that individual worked, 82 percent indicated it was the same as them. Additionally, 94 percent of the discussions regarding the Paragon system occurred face-to-face. See figure five for a graph showing the communication methods used. The subjects also indicated that they perceived the majority of the contacted people had a positive attitude about the system (68%). When asked how strongly that person influenced them on the Paragon system, the subjects suggested there was some influence ($M=5.31$, $SD=2.78$). See figure six for a graph showing the strength of influence.

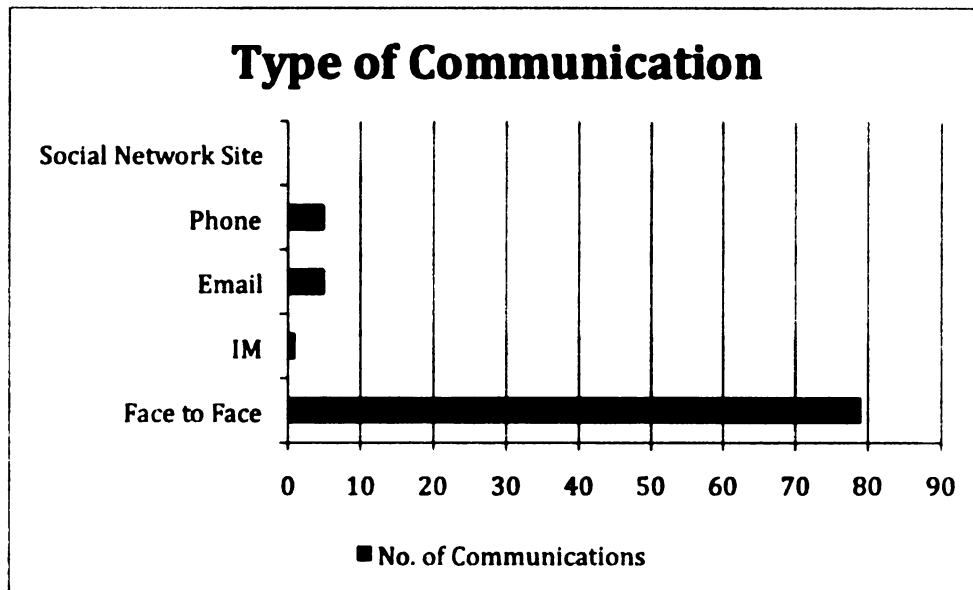


Figure 5: Method of communication

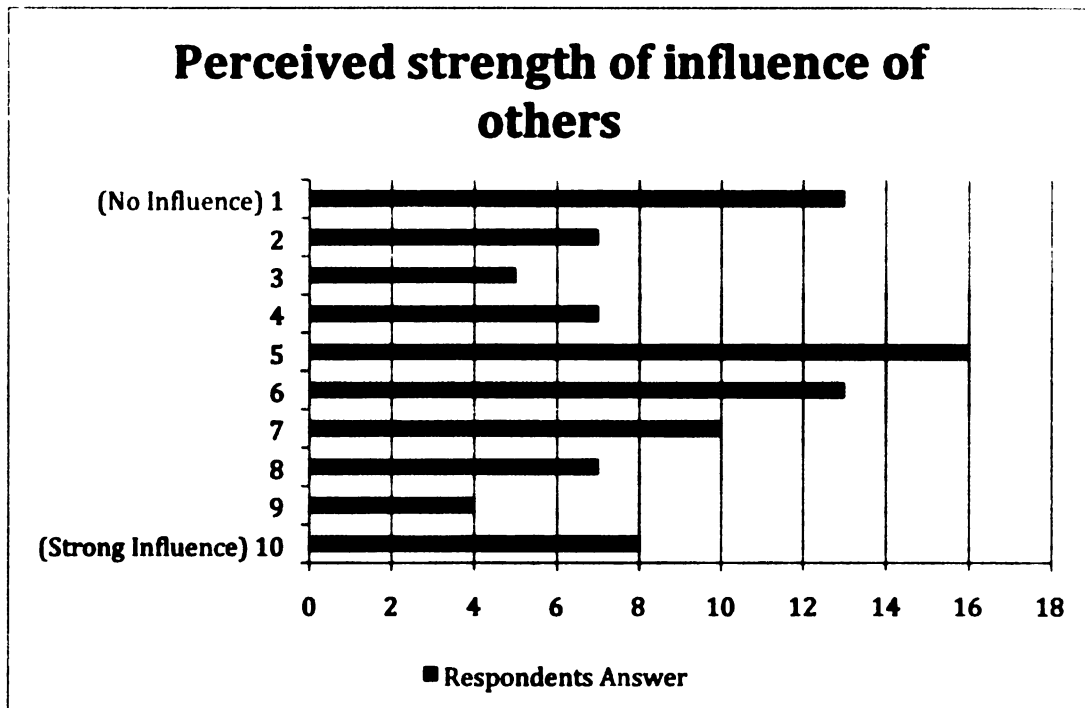


Figure 6: Perceived strength of influence of others

Research question 2a asked about who was sought after regarding the Paragon system and the reasons for this. For the ICU/CCU the average number of people a staff member talked to about the system was 2.68 (range: 1-6,

SD=1.35). By shift, first shift spoke to an average of 2.61 (SD=1.12, range 1-4), second shift had 2.60 (SD=1.82, range 1-5) average contact people and third shift contacted 2.77 (SD=1.48, range 1-6). For the most part, the super users were the most likely to be asked about the Paragon system. The number of super users contacted by other nurses compared to the non-super user nurses contacted by other nurses was submitted to a matched pairs t-test. The number of super user contacts was significantly higher ($M = 2.32$, $SD = 1.24$) than the number of non-super user contacts ($M = 0.35$, $SD = 0.66$), $t(30) = 7.45$, $p < 0.001$, two tailed. See table eight for the analysis of the contacts regarding the Paragon system in the ICU/CCU.

	Contact	Super User	Non-Super User
Overall			
Average	2.68	2.32	0.35
SD	1.35	1.25	0.66
Range	1-6	1-5	0-2
1st Shift			
Average	2.62	2.23	0.38
SD	1.12	1.24	0.65
Range	1-4	1-4	0-2
2nd Shift			
Average	2.60	2.00	0.60
SD	1.82	1.00	0.89
Range	1-5	1-3	0-2
3rd Shift			
Average	2.77	2.54	0.23
SD	1.48	1.39	0.60
Range	1-6	1-5	0-2

Table 8: Contact in ICU/CCU regarding the Paragon system

Computer experience and system knowledge were the main characteristics (52%) the respondents gave about the reasons they went to the individuals they did in regards to the Paragon system. Thirty-nine percent stated that access was a key consideration, meaning the contact individual was around,

on the same shift, and easy to contact. Moreover, having involvement with the system development was also identified by 29 percent of the subjects as a characteristic of being a contacted individual.

Research question 2b asked if there are differences between the ICU/CCU shifts and the other units in the hospital. The interview data suggest that the nurses generally only ask people on their shift about the Paragon system. For example, day shift nurses only spoke to those on the day shift. Afternoon shift had the most overlap, but only with the day shift (two day shift super users nurses and the primary-super user). The night shift's only other out-of-shift contact regarding the Paragon system was with the primary super user. Using this preliminary data, a social network sketch was constructed (See figure five and appendix G for a more detailed social network). Also, the interviewees indicated that not only were the shifts somewhat isolated from each other, they were also segregated from other units in the hospital. When asked if the other departments had a similar structure with the champions and or super users 64.5 percent stated they did not know or were unsure, 22.6 percent reported that other departments did not have this, 9.7 percent answered that their champion (the primary super user) helped other units, and 3.2 percent stated that the ICU/CCU was the only unit with a nurse educator (in this case, the primary-super user).

Summary

Hypothesis one was supported, suggesting social influence is the strongest predictor of intention to use the Paragon system. Another result that

emerged from an examination of social influence was the lack of influence perceived from physicians and upper management of MGH in intention to use the Paragon system. This also demonstrated that performance expectancy characteristics are key in the intended adoption of the EMR system, but not the strongest. The second hypothesis stated effort expectancy would be the weakest construct in nurses' intention to use; this was also supported. Hypothesis three stated that those with high computer self-efficacy would score lower on social influence, however this was not established. Although age and computer self-efficacy were related and younger nurses had higher social influence scores. The results from the interviews suggest that champions were recognized, more by the first and second shift of the ICU/CCU. Characteristics of being a champion included helping design the ICU/CCU section of the Paragon system, it was the individual's job, they were good trainers, and good with using the system. Super users were most likely to be asked about the Paragon system. Also, different departments and shifts seem to be isolated from each other in regards to the Paragon system implementation.

The next chapter concludes this research report with a discussion of the implications for this work, limitations, and possible future research directions.

V. Discussion

This study establishes the importance of having theory-driven research while examining the adoption of an EMR system, setting the stage for more in-depth inquiries to better explain the adoption tendencies of nurses in a hospital setting. The need for these types of insights is increasing, as the implementation

of EMR systems in all health care facilities is inevitable. This research sought to understand the perceptions of nurses during a hospital EMR implementation.

This study has significance for both the academic and health communities. In the academic setting, the findings from this project can extend and refine the UTAUT model for use with nurses to provide a thorough understanding of nurses' technology adoption characteristics also noting the model may not fit the needs of all professions as originally presented. In the health community, the data provide for a better awareness into the impact of social influence and how it can be further utilized in nurse trainings and EMR deployments. Shifting the focus from physicians' perspectives to nurses' provides for an extensive review of the effects and uses of EMRs in a hospital setting. This is important, as nurses are the frontline of delivering and coordinating patient care. They are also often required to utilize an EMR system many times during a shift. It is key to appreciate these perceptions as they can influence the successful adoption of EMR. This research also has implications for society, as the transition from paper records to electronic records has a substantial impact on all citizens. Appreciating the adoption tendencies of nurses can lead to a smoother and faster deployment of EMR systems which can lead to improved patient safety, higher quality of care standards, and lowered costs (Dick & Steen, 1991).

The findings of this research suggest that the UTAUT contributed to knowledge about the nursing population and EMR deployments within a hospital setting, however, some modifications should be made for this population. Past studies have indicated that performance expectancy is the strongest predictor of

intention to use a technology in many stakeholder groups. However, this study demonstrated that social influence is more salient within this nursing population. While performance expectancy still has a significant impact on adoption tendencies, it was not the largest. The data also indicate that effort expectancy in this context may not be as important as once assumed. Another finding demonstrated computer self-efficacy was positively correlated with social influence, suggesting that those with high computer self-efficacy actually seek the approval of those they perceive to be important or influential. Additionally, younger nurses had higher perceptions of computer self-efficacy and thought of it as a reason why other nurses came to them regarding the EMR.

This research also takes the first steps in identifying the structure of a nursing unit during the implementation process of an EMR application. A majority of the nurses identified a champion of the Paragon system, generally either a super user or the primary super user. The data also indicate that the super users had some influence on how others perceived the EMR system. The super users were thought to be people who were comfortable with the system, did it as part of their job, and helped design the ICU/CCU module. The data also suggest that the third shift was somewhat removed from the other shifts and were less likely to perceive a champion of the Paragon system.

The following sections address key implications from this research. The first theme provides suggestions for developing a more robust UTAUT model for nurses. The second implication theme is in regards to the importance of social influence, including a discussion of the super user structure utilized. Finally, the

role of proximity in the diffusion of information concerning McKesson's Paragon System is offered.

UTAUT Model

A better understanding of these intended adoption characteristics will allow researchers and health administrators to better develop any future technology implementation and understand the implications of these emerging structures.

This research demonstrates that the UTAUT model can help explain the adoption tendencies of a nursing population during an implementation of a hospital-based EMR system. However, the results suggest that this model should be further modified in several ways. The first would be to tailor the model to the health care setting and to examine specific health care professionals. This research, along with a handful of past studies demonstrates that nurses are different users of technology than other professional populations may be. Also, modifications should be made to the UTAUT for nurses because they are often the front line of care and communication between patients and other providers, thus making their perceptions of the UTAUT constructs different than other professionals. For instance, nurses and other professionals, such as bankers may have different standards in regards to the attitudes that lead to intention to use a technology. This suggests that the UTAUT model should be tailored to the audience. Therefore, understanding nurse perceptions may enable hospitals to more successfully implement a technology because nurses are often targeted as the first user group among health care providers in a hospital setting. Also, EMR

utilization is often mandatory for nurses in hospitals. The mandatory nature of the EMR use at MGH deserves some consideration, as it may impact the perceived effort in learning a technology.

Regarding the construct of performance expectancy, it was perceived to be significant in the intention to use the EMR system, yet it was not the strongest relationship. This suggests that nurses' perception of productivity may be different from how it is currently measured by the UTAUT model. For example, the UTAUT performance expectancy measure asks respondents if the EMR will enable them to do their tasks quicker. However, when delivering patient care, this may not be the best indicator of what is important in their job. One ICU/CCU nurse said, "If you messed up on somebody who is that sick, you've messed up their whole life" (R5). Another nurse stated that the Paragon system "...takes away from patient care." (R19). A different nurse commented, "I don't want to take the computer into the patient room. I want to talk to the patient, I felt like writing was faster, took less time and took less focus away from the patient" (R21). Thus, a better understanding of individual productivity for nurses' should be further explored. Patient care quality is important to ICU/CCU nurses and there could be a fundamental misalignment of general productivity definitions as used in the UTAUT and the nurses' primary job. However, being able to document medications and procedures may lead to better outcomes, which is what makes the UTAUT performance expectancy construct still applicable to this group.

It is also telling that effort expectancy is not an effective indicator of a person's intention to use a piece of technology; because many people of a certain age have always been surrounded by technology and technology design has advanced, there may not be a perception that most technologies are difficult to use anymore. Also, the overall attitude of an individual, regardless of age, might also be a good indicator of the effort that they perceive they need to apply in learning the EMR system. Also when a system is mandatory in one's job, it may be that the difficulty of the system is no longer relevant. The primary super user stated the attitude of the individual toward the system was a better indicator of use rather than anything inherent in the system. Overall, the UTAUT model is acceptable to use in this population and context; however, it should be further studied to better align the definitions of the constructs to that of the nursing profession.

As social influence was the highest predictor of behavioral intention to use the Paragon system, it has some key implications on the adoption perceptions of nurses and is examined next.

Impact of Social Influence

The nurses at MGH established that perceived social influence was the strongest predictor of intention to use the EMR system. Social influence in this context was defined as the nurses perceiving certain important individuals to think it was valuable for them to use the EMR system. As the majority of nurses are women in the U.S., there may be some gender issues associated with social

influence. In fact, Venkatesh and colleagues (2000) have suggested this may be the overall case with women and may change over time stating, “women consider inputs from a number of sources... when making technology adoption and usage decisions” (p. 129). However, it could also be characteristic of a nurse population, regardless of gender. This finding is confounded in this study, as nurses tend to have similar personality traits. People who tend to go into the nursing field have been found to be caring, empathetic, strong communicators, and have high people skills (Carpenter, 1995; Smith & Godfrey, 2002). Additionally, physicians’ influence was not perceived to be very strong by the nurses. This could be because, in this implementation, physicians were allowed to opt out of using the Paragon system, while use was mandatory for the nurses. This finding should be further studied as much of past research specifically focuses on the adoption and perceptions of physicians’ in an EMR deployment (Miller and Sim, 2004; Menachemi, Matthews, Ford, Hikmet, & Brooks, 2009; Schoen, Oscorn, Doty, Squires, Peugh, & Applebaum, 2009) even though their influence was not perceived to be relevant for the nurses at MGH. This finding also highlights a paradigm shift in the health community, where physicians may no longer be seen as the superior to the nurses, especially in regards to technology adoption (Gargin & Garelick, 2004). Their perception of social influence may also be an indication that the nurses were more concerned with the impressions of certain others (e.g., other nurses) rather than any sort of job performance or improved productivity that the Paragon system could provide. This could impact how health organizations present and deploy EMR system for

example, they could focus less on rewards for utilization and more on identifying champions for the systems.

Additionally, when analyzing the interview data, it was apparent that there is an interaction between an individual's age and social influence. The data suggest if an individual is younger, they are perceived by others to be good at using the EMR system and technology in general. Yet, those same individuals continue to seek out approval from others for using the EMR system. This may be an artifact of being part of the "digital native" generation (Presnsky, 2001). Another possible explanation for this could also be that the younger nurses are newer to the profession and seeking approval from superiors in order to have good performance reviews, receive promotions, and raises. The super user structure utilized in the ICU/CCU appeared to be successful, in the sense that people were turning to the pre-identified individuals for assistance. In this department, this technique seemed to have been an effective way to disseminate knowledge regarding the system. This included negative perceptions as well. This propagation of information through this network should be more fully examined.

Along with the influence of social network, the impact of the proximity to colleagues regarding the system also played a key part in the perceptions of deployment of the Paragon system.

Parameters of Work

While this was not a rigorous examination into the social network of the ICU/CCU nurses regarding the Paragon system, it is a foundation on to which

further documentation can be made. Due to the nature of the shift work and department separations, the organizational structure of the ICU/CCU and the hospital seemed to make the proximity (both time and location) important to the dissemination of knowledge, specifically the EMR system. Overall there was very little overlap of information sharing between the shifts in the ICU/CCU. As patients are admitted and treated in all shifts in the ICU/CCU, it is important to examine the differences between the day and afternoon shift and the night shift. Generally, night shifts (also weekend and holiday shifts) have less support staff and fewer physicians in the hospital (Shulkin, 2008). Third shift nurses are also more likely to be younger and have less experience than first or second shift nurses (Shulkin, 2008). Other studies have documented increased medical errors, including medication errors and mortality during the third shift (Saposnik, Bailbergenova, Bayer, & Hachinski, 2007; Hendy, Barth, & Soliz, 2005). The difference of perceptions of the night shift was also apparent in their intention to use the Paragon system, as they were less likely to recognize a champion of the Paragon system in their department. Perhaps this was because the primary super user (the individual who was most likely to be named the champion) did not normally work on the night shift. A comment from a nurse who works on the night shift also seems to suggest that there is separation between her shift and the others, "I didn't see any of that [practice time on the computers], unless they only did it on day shift" (R22). It should be noted that the equipment was not set up in time for any of the shifts to practice, as it was originally intended to be, but the fact remains that this nurse did not know if they had that opportunity on any

of the other shifts. Also, second shift was the only shift that acknowledged seeking out people from another shifts, specifically, the first shift. Past studies have demonstrated that shift assignment can influence nurses' perceptions and attitudes, including having a "psychological separation [between shifts]" and increased similarities among the same shift (Parasuraman, Drake, & Zammuto, 1982). This finding could indicate that more resources (such as flexible training schedules) should be directed to the third shift than to others in order to ensure quality of care is continued throughout all shifts. Additionally, this could be an outcome of this ICU/CCU's patient-round structure (rounds are only conducted on first shift) and should be further investigated.

Limitations

As is the case with even the most thought-out research endeavors, this effort is not without its limitations. Some of these include the lack of complete responses to the social network analysis questions through the online survey. While providing a complete roster of names available to the subjects to select may have increased the response, it would have been very tedious for the respondents as there are approximately 200 medical employees and 3000 staff members employed by MGH. Also, when conducting interviews in the ICU/CCU, it was clear that time was carefully managed and patient care was of the utmost importance, therefore it was impossible to have the nurses complete a roster of their communication during the interview process. However, the structure of the super users and the primary super user made it feasible to draw an informal sketch of the communication structure of the Paragon system. Another limitation

to this research was the one time survey methodology utilized. This study measured one point of time at the beginning of the EMR implementation before use of the system. This study can be the foundation for future longitudinal research at this hospital for a deeper understanding of the adoption characteristics of this population. Also, follow-up for non-respondents was difficult as this data collection had a short time frame once the system went live and it would have most likely impacted the responses. It was also reported by the MGH contact to the researcher that nurses who were thought to be the most computer illiterate (e.g., did not know how to use a mouse) were opting not to participate in the online survey. Finally, this survey examined one hospital setting using a particular EMR (Paragon) system and the nurses from the ICU/CCU. Future research should be expanded to document other hospitals, EMR systems, and departments.

Future directions

Research in this field is continually evolving, allowing for a plethora of research studies to be conducted. The social network analysis should be continued and further documented from this perspective. A rigorous analysis of the social network in this context can lead to an assiduous understanding of the emergent communication structures in a health care setting, which can afford important insight to communication and information system researchers, hospital administrators, HIT developers and trainers. The social network analysis could help redistribute resources, concentrate on better training for super users and developing champions, as well as focusing on specific shifts and departments.

Also, the redevelopment and the extension of the UTAUT used in this type of setting is another further step in this line of study. There are several extensions to the UTAUT model that can be made. First, a redesigned model should seek to make a distinction between different types of professionals. Next, the definition of performance expectancy should also be further refined to target the divergent meanings and perceptions of productivity. Also, effort expectancy needs to be modified to better be able to discern true challenges of using technology, as it is ubiquitous to many, especially younger populations. Finally, while this research project exclusively examined nurse perceptions it is also important to document the differences between physicians and nurses. This comparison has two primary benefits. First it would allow for a better refinement of the UTAUT model in developing it for specific professions. Second, this will provide a deeper understanding of the perceptions of adoption and implementation to ensure more successful deployments and assist health care organizations in gaining meaningful use of the EMR system. These refinements to the UTAUT would allow for more exact measurements of the intention to adopt technologies, specifically noting the context and setting of the work environment and populations. Possible next steps in this research include performing a full social network analysis, working toward the development of a UTAUT model specifically for nurses, and to create deployment processes based on the findings of this project. This future research is in line with many of the objectives of government agencies, such as the National Institutes of Health (NIH), the Agency for Healthcare Research and Quality (AHRQ), Centers for Disease

Control (CDC) and the Health Resources and Services Administration (HRSA).¹

There are also several recommendations for practical applications of this research.

Practical Implications

This research also has many practical implications not only for Marquette General Hospital, but other hospital administrators and IT managers planning on deploying an EMR system. Three overall themes emerged from this research and are presented and discussed. These themes include resource allocation, training recommendations, and communication suggestions.

Resource Allocations

While there are invariably limitations on the resources available to organizations, some minor adjustments to these can support a successful EMR deployment. First, the research demonstrated there was a disparity in perceptions of the EMR system by the third shift. The third shift nurses were less inclined to name a champion of the Paragon system, while the first and the second shift were more likely to name the primary super user as the champion. Therefore, a recommendation is to have the primary super user spend more time on the third shift during the deployment of the system. Furthermore, several of the third shift nurses indicated that when they contacted the IT help desk, they were informed that they had to wait until morning when more experienced help

¹ Many of these agencies currently have funding available for EMR deployment research, examples include: HRSA-09-199, HRSA-09-198, CDC-RFA-IP10-1002ARRA10, PAR-07-412, PAR-08-270, PAR-08-268

desk staff were on shift. This suggests that experienced and well-trained IT help desk members should be placed on all shifts. Additionally, the super user structure utilized in the ICU/CCU was ostensibly effective in supporting others and disseminating information throughout the unit regarding the Paragon system, thus leading to the unit to be considered high-level Paragon users among all of the other departments. The clinical nurse director of the ICU/CCU was able to authorize the super users to have no patient assignments for the first two weeks, permitting them to help the other nurses to better operate the system. The ICU/CCU specifically budgeted for this extra expense; other units should be encouraged to follow this model. Also, additional attention also needs to be directed to training procedures.

Training Recommendations

Nursing is different than many other professions; computer use among nurses can greatly vary. Therefore, it is suggested that a mandatory basic computer-training course be provided by the hospital, before the EMR training, during nurses' shifts. In order not to misuse the time of those that have high computer experience, nurses should have the option to "test-out" of this training. Additionally, the trainer of these systems should be an IT person or a nurse with strong skill in using the system, as opposed to general hospital trainers. Furthermore, while it was planned to have the computer equipment in the units before the "go-live," this did not happen. More efforts should be made to ensure this extra training opportunity is provided. Along with training nurses on the

Paragon system, there are additional opportunities for communicating the importance of the EMR system to the staff.

Communication Campaigns

Enhancing the visibility of upper management may improve the perceptions of the system among the nurses. Past research suggests that initial positive impressions before the deployment of an EMR can improve the perceptions longitudinally (Whitten, Buis, Mackert, 2007). This can be accomplished through different methods, including having the management email progress reports of the deployment and the impacts of the system. Moreover, “town hall”-style meetings would provide opportunities for a dialogue between the staff and the upper level administrators regarding the system. Additionally, having members of upper management visit shift meetings can assist the nurses further in their understanding of the rationale behind EMR deployment decisions. During each of these opportunities, emphasis on the positive implications for improved patient care should be discussed, as this is an important issue for nurses.

Conclusion

This research sought to better understand the adoption characteristics and perceptions of nurses at a rural hospital during an EMR system implementation. It also investigated the emerging social network of intensive care nurses regarding the EMR system being deployed. This investigation can serve as a foundation for future theory-based research in this setting. As EMR systems will

be commonplace and required in the future of health care, it is necessary to appreciate the impacts of these systems on the structure of communication and dissemination of perceptions and attitudes. Improved implementations and deployments of EMRs may lead to faster realizations of better health outcomes and lowered health costs. Also, in a recent *Health Affairs* article, DeVore and Figlioli (2010) state there are significant lessons that ought to be implemented during an EMR deployment, including hands-on-training, recognizing the value of clinical champions, and developing flexible budgets. These lessons were in fact utilized during this EMR implementation; however, there is no theoretical base for these, which is a significant portion of truly understanding the processes in play. This type of examination would provide for a more thorough insight into why these lessons are effective and to what extent. The findings presented here are complimentary to these observations and it is hoped that they can be another piece in interpreting this momentous shift in health care delivery.

Appendix A: Matrix of UTAUT Construct Definitions

Construct	Definition	Foundations of Model
Performance Expectancy	The degree to which an individual believes that using the system will help him or her to attain gains in job performance.	Perceived usefulness (TAM/TAM2, TAM/TPB), extrinsic motivation (MM), job-fit(MPCU), relative advantage (IDT), outcome expectations (SCT)
Effort Expectancy	The degree of ease associated with the use of the system	Perceived ease of use (TAM/TAM2), complexity (MPCU), ease of use (IDT)
Social Influence	The degree to which an individual perceives that important others believe he or she should use the new system.	Subjective norm (TRA, TAM2, TPB, TAM/TPB), social factors (MPCU), image (IDT)
Facilitating Conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.	Perceived behavioral control (TPB, TAM/TPB), facilitating conditions (MPCU), compatibility (IDT)

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27, 425-478.

Table 9: Matrix of UTUAT construct definitions

Appendix B: McKesson Paragon Screenshots

☐	000	12. and Subcategory 12. Feb 14, 2010 7:50PM	
☐	000	Drain Feb 14, 2010 7:52PM	
☐	000	Initial Feb 14, 2010 7:54PM	
☐	000	Nurse to Perform Blood Swab for Screen Feb 14, 2010 7:57PM	
☐	000	O1 Evaluation and Treatment Feb 14, 2010 7:59PM	
☐	000	Other Case Mgt Request Feb 14, 2010 7:59PM	
☐	000	R1 Evaluation and Treatment Feb 14, 2010 7:59PM	
☐	000	R1 Adrenal Block Doc Feb 14, 2010 8:22PM	
☐	000	R1 Continual Care Feb 14, 2010 7:59PM	
☐	000	R1 Ventilatory Parameters Feb 14, 2010 7:59PM	
☐	000	S1 Swallow Evaluation 8 Trial Feb 14, 2010 7:59PM	
☐	000	Treatment Feb 14, 2010 7:59PM	

Figure 7: McKesson Paragon screenshot

Screenshots from McKesson's Paragon System (2)

	02/15/2019 08:07	02/14/2019 21:06	02/14/2019 08:52	02/14/2019 21:06	02/14/2019 08:52	02/14/2019 18:12	02/14/2019 18:06	02/14/2019 12:06	02/14/2019 18:06	02/14/2019 11:06	02/14/2019 15:07	02/14/2019 14:56	02/14/2019 12:06	02/14/2019 12:06	02/14/2019 11:06	02/14/2019 15:06
AB	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Vitals																
Temp	98.8 F	99.3 F			98.6 F	98.6 F		98.6 F	98.6 F		98.1 F		97.7 F		97.3 F	97.3 F
HR	82	76			78	72		70	86		88		82	82	82	82
Resp	15	21			14	12		14	18		18		20		15	18
O2 Sat	85%	99%			93%(RA 100)	98%(RA 5%)		88%(21%)	87%(21%)		88%(21%)		100%(21%)	100%(21%)	100%(21%)	100%(21%)
MAP	80	85				102										
BP	95/60	106/65				139/71										
BP2 MAP		76			72	92		80			80		80	78	84	84
BP2		128/52			132/54	186/84		198/64			154/64		134/58	130/55	136/80	136/62
BP Art									152/82							
Art MAP									86							
CVP		7 mmHg			8 mmHg	5 mmHg		7 mmHg	8 mmHg		9 mmHg		11 mmHg	11 mmHg	10 mmHg	10 mmHg
PAP		31/15			38/14	27/8		28/13	28/16		31/17		134/58	30/15	30/15	28/15
PAM		22			21	17		20	22		24		80	22	22	22
CI									2.3							
CO									4.5							
MO																

Figure 8: McKesson Paragon Screenshot (2)

Appendix C: Nurse Training Notification

(EMAIL)

It's Here! The Electronic Medical Record Training Schedule!

Classes are currently scheduled for:

- Registered Nurses**
- Licensed Practical Nurses**
- Clinical Care Aides**
- Unit Clerks**

From the following units/departments:

- Surgical**
- Medical/Oncology**
- Cardiac**
- Neuro/Ortho/Peds**
- Rehab**
- Inpatient BHS**
- Outpatient Surgery**
- Quality Management**
- ICU/CCU/IMCU**
- Endoscopy**
- FBC/NICU**
- Hemodialysis**
- ARE/PAT**

Please register your staff or have them follow instructions on the attached announcement to register for one of 16 classes.

REALLY IMPORTANT! PLEASE NOTE:

Each class meets 4 times (four 4-hour sessions)

Clinical Care Aides may only register for one of three classes: Class #5, Class #10, or Class #15

Unit Clerks may only register for one of three classes: Class #4, Class #8, or Class #14

RNs and LPNs may register for any class: #1 - #16

Separate training will be scheduled for ED, OR, Anesthesia, PT/OT/Speech/Audiology, RT, Radiology, Special Procedures, Dieticians, Dietary, SW (Care Management), Perfusion, Rehab Care (outpatient), Home Health, OutPatient Cardiac, Clinics, others. Please watch for details.

Appendix D: Survey Instrument

Are you currently a LPN or RN?

- ☐ Yes
☐ No

As part of your daily job routine, do you actively provide direct patient care?

- ☐ Yes
☐ No

Please check the answer you feel best fits each statement

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I would find the Paragon application useful in my job	1	2	3	4	5
Using the Paragon application will enable me to accomplish tasks more quickly	1	2	3	4	5
Using the Paragon application will increase my productivity.	1	2	3	4	5
If I use the Paragon application, I will increase my chances of getting a raise.	1	2	3	4	5
If I use the Paragon application, I will increase my chances of getting a promotion	1	2	3	4	5

Please check the answer you feel best fits each statement

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I understand how much effort I will have to expend to use the Paragon application	1	2	3	4	5

I would be able to understand how to accomplish my tasks using the Paragon application.	1	2	3	4	5
It would be easy for me to become skillful at using the Paragon application	1	2	3	4	5
I would find the Paragon application system easy to use.	1	2	3	4	5
Learning to operate the Paragon application is easy for me.		2	3	4	5
The Paragon application is a very challenging application to learn.	1	2	3	4	5
The Paragon application will be difficult to adapt to in my everyday work.	1	2	3	4	5

Please check the answer you feel best fits each statement

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Nurses in my department think that I should use the Paragon application.	1	2	3	4	5
Other nurses in Marquette General Hospital think that I should use the Paragon application.	1	2	3	4	5
Doctors in Marquette General Hospital think that I should use the Paragon application	1	2	3	4	5
The management of Marquette General Hospital thinks that I should use the Paragon application.	1	2	3	4	5

Please check the answer you feel best fits each statement

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
People who influence my behavior think that I should use the Paragon application.	1	2	3	4	5
People who are important to me think that I should use the Paragon application.	1	2	3	4	5
The senior management of Marquette General Hospital has been helpful in the use of the Paragon application.	1	2	3	4	5
In general, Marquette General Hospital has supported the use of the Paragon application.	1	2	3	4	5

Please check the answer you feel best fits each statement

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I have received the necessary training to use the Paragon application.	1	2	3	4	5
I have received sufficient information regarding the Paragon application/	1	2	3	4	5
Marquette General Hospital has sufficient computer equipment to run the application/	1	2	3	4	5
I have the resources necessary to use the Paragon application.	1	2	3	4	5
I have the knowledge necessary to use the Paragon application.	1	2	3	4	5

The Paragon application is not compatible with other systems I use.	1	2	3	4	5
A specific person (or group) is available for assistance with system difficulties.	1	2	3	4	5

Please check the answer you feel best fits each statement

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I plan to use the Paragon application only to the required minimal level necessary in the next 3 months	1	2	3	4	5
I plan to use the Paragon application to the fullest extent in the next 3 months	1	2	3	4	5
I plan to use the Paragon system to look up patient results.	1	2	3	4	5
I intend to use the Paragon application in the next 3 months.	1	2	3	4	5

How long have you been working in your profession?

- ☐ Less than 1 year
- ☐ 1 to 4 years
- ☐ 5 to 9 years
- ☐ 10 to 14 years
- ☐ 15 to 19 years
- ☐ 20 to 24 years
- ☐ 25 to 29 years
- ☐ 30 or more years

How long have you been working at MGH?

- ☐ Less than 1 year
- ☐ 1 to 4 years
- ☐ 5 to 9 years
- ☐ 10 to 14 years
- ☐ 15 to 19 years
- ☐ 20 or more years

What is your age?

- ☐ 18 to 19 years old
☐ 20 to 29 years old
☐ 30 to 39 years old
☐ 40 to 49 years old
☐ 50 to 59 years old
☐ 60 years old or older

What is your highest level of education completed?

- ☐ Associates degree
☐ Some bachelor degree studies
☐ Bachelor degree
☐ Some master degree studies
☐ Master degree
☐ Some doctoral studies
☐ PhD degree or other professional degree

What is your gender?

- ☐ Male
☐ Female

Please check the answer you feel best fits each statement
I could complete my job tasks using the Paragon system...

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
If there was no one around to tell me what to do	1	2	3	4	5
If I had never used a system like it before	1	2	3	4	5
If I only had Paragon manuals for reference	1	2	3	4	5
If I had seen someone else using it before trying it myself	1	2	3	4	5
If I could call someone for help if I got stuck	1	2	3	4	5
If someone else had helped me get started	1	2	3	4	5
If I had a lot of time to complete the job with the system	1	2	3	4	5
If I had just the built-in help facility for assistance	1	2	3	4	5

If someone showed me how to do it first	1	2	3	4	5
If I had used a similar system before this one to do the same tasks.	1	2	3	4	5

This section focuses on your professional interactions and sources of new knowledge, especially with regard to the Paragon application.

(Reminder: No identifiable information will be released to Marquette General Hospital)

Your Information

Your Name: _____

Your Title: _____

Your Department: _____

During the last month have you discussed the Paragon application with other medical professionals?

- ☐ Yes
☐ No

Who have you discussed the Paragon application with?

Your Name: _____

Your Title: _____

Your Department: _____

Does this person work at:

- ☐ Marquette General Hospital
☐ Another health care facility

Does this person work at:

- ☐ On the same shift as you
☐ On a different shift
☐ Not applicable/Not sure

What was your main form of communication with that person?

- ☐ Face to face
☐ Email
☐ Phone

- ☐ Instant messaging
- ☐ Written notes
- ☐ Social network sites (Facebook, Myspace, etc.)

Overall, was this person's attitude toward the Paragon system:

- ☐ Positive
- ☐ Negative

On a scale, 1-10, 1 being no influence and 1 being strong influence, how much overall influence does this person have on your thoughts regarding the Paragon system.

- ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Is there another person you have discussed the Paragon application with?

- ☐ Yes
- ☐ No

[Author's note: If the respondent selected yes they would be asked about that person, this would repeat until they checked no. Selecting no ends the survey.]

Appendix E: Interview guide

What were your initial feelings regarding the implementation of the Paragon system? Have they changed? In what way?

If you have a question regarding the system, who is the first person you turn to? (Name super users) Why?

If you have a problem regarding the system, who is the first person you turn to? Why?

Do you people come to you for help with the Paragon system? Why do you think that is?

Would you say there was a champion of the Paragon for your department? Why this person? What role did this person play in the implementation? Do you think other departments had this? How do you think your department's champion is different than others?

Would you like to add anything else?

Appendix F: Factor Analysis

Table 10: Factor Analysis Results

	Component			
	SI	EE	BI	PE
I would find the Paragon application useful in my job	.101	.040	.340	.800
Using the Paragon application will enables me to accomplish tasks more quickly.	.253	.398	.167	.739
Using the Paragon application will increase my productivity.	.221	.381	.048	.779
I would be able to understand how to accomplish my tasks using the Paragon application.	.219	.667	.089	.248
It would be easy for me to become skillful at using the Paragon application	.168	.834	.235	.111
I would find the Paragon application system easy to use.	.226	.783	.107	.348
Learning to operate the Paragon application is easy for me.	.137	.831	.232	.069
Nurses in my department think that I should use the Paragon application.	.780	.089	.237	.285
Other nurses in Marquette General Hospital think that I should use the Paragon application.	.822	.173	.105	.163

Doctors in Marquette General Hospital think that I should use the Paragon application.	.689	.279	.075	.044
People who influence my behavior think that I should use the Paragon application	.812	.126	.055	.056
People who are important to me think that I should use the Paragon application.	.790	.123	.149	.119
I plan to use the Paragon application only to the required minimal level necessary in the next 3 months.	.073	.183	.627	.111
I plan to use the Paragon application to the fullest extent in the next 3 months.	.248	.302	.729	.074
I plan to use the Paragon System to look up patient results.	.071	.134	.876	.163
I intend to use the Paragon application in the next 3 months.	.133	.011	.860	.126

Table 10 (continued): Factor Analysis Results

	Initial Eigenvalues			Total Variance Explained			Rotation Sums of Squared Lo		
	Total	% of Var	Cumulative	Total	% of Vari	Cumulative %	Total	% of Variance	Cumulative %
1	6.54	40.892	40.892	6.543	40.892	40.892	3.402	21.26	21.26
2	1.94	12.121	53.013	1.939	12.121	53.013	3.039	18.992	40.252
3	1.67	10.463	63.475	1.674	10.463	63.475	2.688	16.801	57.053
4	1.15	7.205	70.681	1.153	7.205	70.681	2.18	13.628	70.681
5	0.94	5.849	76.529						
6	0.81	5.053	81.583						
7	0.59	3.704	85.287						
8	0.49	3.031	88.317						
9	0.41	2.564	90.882						
10	0.33	2.061	92.943						
11	0.3	1.864	94.806						
12	0.22	1.396	96.202						
13	0.21	1.336	97.538						
14	0.19	1.157	98.695						
15	0.15	0.952	99.647						
16	0.06	0.353	100						

Table 11: Factor analysis results summary

Appendix G: Social network sketch

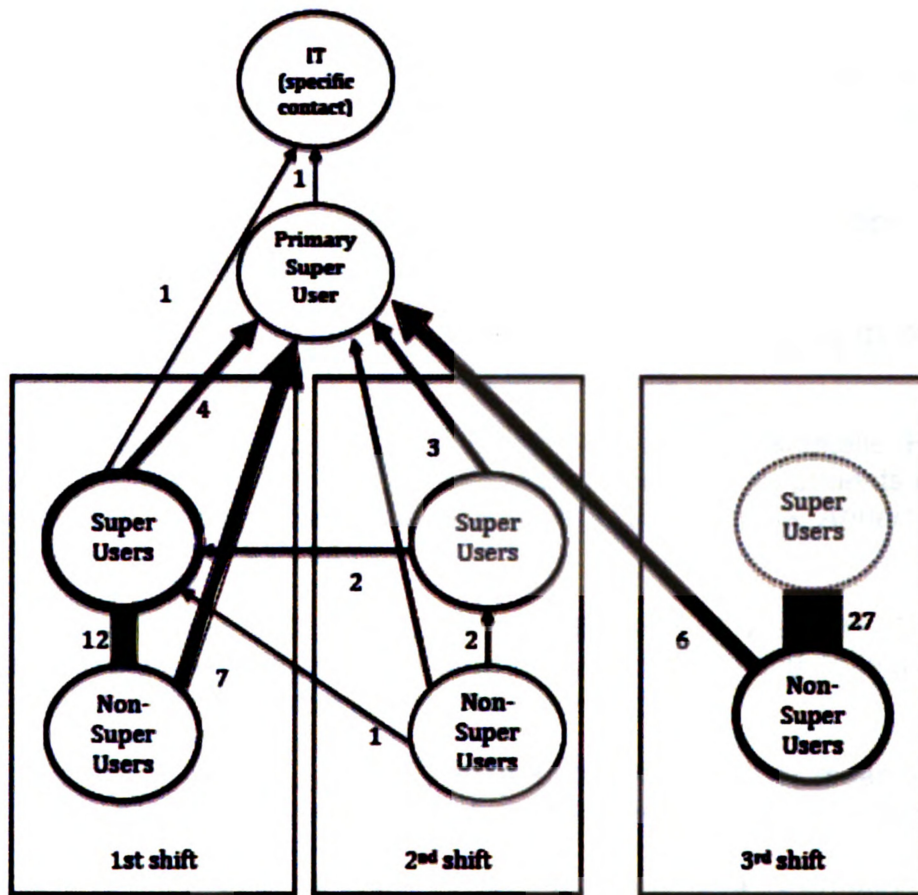


Figure 11: ICU/CCU social network structure

- The number next to a line indicated the number of people who stated they spoke to that specific group
- The thickness of the lines indicated how many people stated they went to the other group, however since 2nd shift has less people represented their lines are skewed
- The 3rd shift was unlikely to speak to anyone on 1st or 2nd shift, why it is further away from the other shifts
- If a member of a group said someone else in that group (i.e., a 1st shift SU named another 1st SU), the circle got thicker
- The 3rd shift SU circle is perforated because no SU got interviewed

1st shift: 12 people interviewed, 4 SU and 8 NSU

2nd shift: 5 people interviewed, 3 SU and 2 NSU

3rd shift: 13 people interviewed, 0 SU and 13 NSU

References

Ackerman, M. J. (2007). The personal health record. . *The Journal of medical practice management*, 23, 84-85.

Agarwal, R., & Prasad, J. (1999). Are individual differences germane to the acceptance of new information technologies? *Decision Sciences*, 30, 361-391.

Agency for Healthcare Research and Quality. (2001). Reducing and Preventing Adverse Drug Events To Decrease Hospital Costs. *Research in Action, Issue 1*, from <http://www.ahrq.gov/qual/aderia/aderia.htm>

American Nursing Association. (2004). Nursing Scope and Standards of Practice. Retrieved August 26, 2009, from www.nursebooks.org

Asch, S. M., McGlynn, E. A., Hogan, M. M., Hayward, R. A., Shekelle, P., Rubenstein, L., et al. (2004). Comparison of quality of care for patients in the Veterans Health Administration and patients in national sample. *Annals of Internal Medicine*, 141, 938-945.

Aydin, C. E., Anderson, J. G., Rosen, P. N., Felitti, V. J., & Weng, H. C. (2004). Computers in the consulting room: a case study of clinician and patient perspectives *Health Care Management Science*, 1, 61-74.

Baer, I., & Mihalich-Levin, L. (2009). ARRA & HIT What do they mean to you: An update on the EHR incentives.: Association of American Medical Colleges.

Bahensky, J. A., Janna, M., & Ward, M. (2008). Health care information technology in rural America: Electronic medical record adoption status in meeting the national agenda. *National Rural Health Association*, 24, 101-105.

Bandura, A. (1977). Self-Efficacy: Toward a Unifying Theory of Behavioral Change. *Psychology Review*, 84, 191-215.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Barnes, J.A. (1979). Network analysis: Orienting notion, rigorous technique or substantive field of study. In *Perspectives on Social Network Research* (eds. Holland & Leinhardt). New York: Academic Press.

Batagelj, V., & Mrvar, A. (2008). Pakej.

Bates, D. W. (2000). Using information technology to reduce rates of medication errors in hospitals. *BMJ*, 320, 768-770.

Bates, D. W., Ebell, M., Gotlieb, E., Zapp, H., & Mullins, H. C. (2003). A proposal for electronic medical records in U.S. Primary Care. *JAMIA*, 10, 1-10.

Bates, D. W., Leape, L. L., DJ, C., & et al. (1998). Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *JAMA*, 280, 1311-1316.

Bates, D. W., Leape, L. L., DJ, C., Laird, N., Petersen, L. A., Teich, J. M., et al. (1998). Effect of computerized physician order entry and a team intervention on the prevention of serious medication errors. *JAMA*, 280, 1311-1316.

Bates, D. W., Spell, N., Cullen DJ, & al, e. (1997). The costs of adverse drug events in hospitalized patients. *JAMA*, 277, 307-311.

Baum, F. (1995). Researching public health: Behind the qualitative-quantitative methodological debate. *Social Science and Medicine*, 40:459-468.

Bickford, C. J., Smith, K., Ball, M. J., Grantz, G., Panniers, T. L., Newbold, S. K., et al. (2005). Evaluation of a nursing informatics training program shows significant changes in nurses' perception of their knowledge of information technology *Health Informatics Journal*, 11, 225-235.

Blegind-Jensen, T., & Aanestad, M. (2007). Hospitality and hostility in hospitals: A case study of an ERP adoption among surgeons. *European Journal of Information Systems*, 16, 672-680.

Blumenthal, D. (2009). Stimulating the Adoption of Health Information Technology. *New England Journal of Medicine*, 360, 1477.

Blumenthal, D., & Glaser, J. P. (2007). Information technology comes to medicine. *The New England Journal of Medicine*, 356, 2527-2534.

Brass, D. J., & Burkhardt, M. E. (1993). Potential Power and Power Use: An Investigation of Structure and Behavior. *The Academy of Management Journal*, 36, 441-470.

Brilli, R.J., Spevetz, A., Banson, R.D., et al. (2001). Critical care delivery in the intensive care unit: Defining clinical roles and best practice model. *Critical Care Medicine*, 29:459-468.

Brooks, R. G., Menachemi, N., Burke, D., & Clawson, A. (2005). Patient safety-related information technology utilization in urban and rural hospitals *Journal of Medical System*, 29, 103-109.

Bryman, A. (2006). Integrating quantitative and qualitative methods: How's it done? *Qualitative Research*, 6, 97-113.

Buerhaus, P. I. (2008). Current and future state of the US nursing workforce. *JAMA*, 300, 2422-2424.

Buerhaus, P. I., Auerbach, D. I., & Staiger, D. O. (2009). The recent surge in nurse employment: Causes and implications. *Health Affairs*, 28, 657-668.

Bureau of Labor Statistics. (2008-09 Edition). Health Care. *Career Guide to Industries*. Retrieved August 17, 2009, from <http://www.bls.gov/oco/cg/cgs035.htm>

Burkhardt, M.E., and Brass, D.J. (1990). Changing patterns and patterns of change: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly* 35:104-127.

Casey, M. M., Wakefield, M., Coburn, A. F., Moscovice, I. S., & Loux, S. (2006). Prioritizing Patient Safety Interventions in Small and Rural Hospitals. *Joint Commission Journal of Quality and Patient Safety*, 32, 696-702.

Chang, I. C., Hwang, H. G., Hung, W. F., & Li, Y. C. (2007). Physicians' acceptance of pharmacokinetics-based clinical decision support systems *Expert Systems with Application*, 33, 296-303.

Chau, P.Y.K. & Hu, P. (2002). Investigating healthcare professionals' decision to accept telemedicine technology: an empirical test of competing theories. *Information and Management*, 39:297-311.

Chismar, W. G., & Wiley-Patton, S. (2002). *Test of technology acceptance model for the Internet in pediatrics*. Paper presented at the AMIA Annual Symposium Proceedings.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *The New England Journal of Medicine*, 357, 370-379.

Clarke, P.N. & Yaros, P.S. (1988). Research blenders: Commentary and response. *Nursing Science Quarterly*, 1: 47-149.

Cott, C. (1197). "We decide and you carry it out": A social network analysis of multidisciplinary long term care teams. *Social Sciences and Medicine*, 45, 1411-1421.

Courtney, K. L., Demiris, G., & Alexander, G. (2005). Information technology: Changing nursing processes at the point-of-care. *Nursing Administration Quarterly*, 29, 315-322.

Creswick, N., & Westbrook, J. J. (2007). *The medical advice seeking network of staff*. Netherlands: IOS Press.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16: 297-334.

Crosson, J. C., Ohman-Strickland, P. A., Hahn, K. A., DiCicco-Bloom, B., Shaw, E., Orzano, A. J., et al. (2007). Electronic medical records and diabetes quality of care: Results from a sample of family medicine practices. *Annals of Family Medicine*, 5, 209-215.

Daft, R.L. & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science* 32:554-571.

Darr, A., Harrison, M. I., Shakked, L., & Shalom, N. (2003). Physicians' and nurses' reactions to electronic medical records: Managerial and occupational implications. *Journal of Health Organisation and Management*, 17, 349-359.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 319-339.

de Nooy, W., Mrvar, A., & Batagelj, V. (2005). *Exploratory social network analysis with Pajek*. New York: Cambridge University Press.

DeSanctis, G., & Poole, M.S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science* 5:121-147.

DeVore, S.D. & Figlioli, K. (2010). Lessons premier hospitals learned about implementing electronic health records. *Health Affairs*, 29:664-667.

Dick, R. S., & Steen, E. B. (Eds.). (1991). *The computer-based patient record: An essential technology for health care*. Washington, D.C.: National Academy of Press.

Dillon, T. W., Blankenship, R., & Crews, T. (2005). Nursing attitudes and images of electronic patient systems. *CIN: Computers, Informatics, Nursing*, 23, 139-145.

Eagley, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Orlando, FL: Harcourt Brace Jovanovich College Publisher.

El-Kareh, R., Gandhi, T. K., Poon, E. G., Newmark, L. P., Ungar, J., Lipsitz, S., et al. (2009). Trends in Primary Care Clinician Perceptions of a New Electronic Health Record. *Journal of General Internal Medicine*, 24, 464-468.

Eng, P. H. (1993). The dave our sisters project. A social network strategy for reaching rural black women. *Cancer*, 72, 1071-1077.

Fattore, G., Frosini, F., Salvatore, D., & Tozzi, V. (2000). Social network analysis in primary care: The impact of interactions on prescribing behavior. *Health Policy*, 92, 141-148.

Ferrell, D. K., & DeBord, C. L. (2003). Make computer-based training user-friendly. *Nursing Management*, 34, 30-31.

Fischer, M. A., Vogeli, C., Stedman, M., Ferris, T., Brookhard, M. A., & Weissman, J. D. (2008). Effects of electronic prescribing with formulary decision support on medication use and cost. *Archives of Internal Medicine*, 168, 2433-2439.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Flemming, K. (2007). The knowledge base for evidence-based nursing: A role for mixed methods research? *Advances in Nursing*, 30: 41-51.

Forthofer, M. S. (2003). Status of mixed methods in the health sciences. . In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* Thousand Oaks: Sage.

Freeman, L. C. (1979). Centrality in social networks: Conceptual clarification. *Social Networks*, 1, 215-239.

Freeman, L. C. (1998). Social network and the structure experiment. In L. C. Freeman, D. R. White & A. K. Romney (Eds.), *Research methods in social network analysis*. Fairfax, VA: George Mason University Press.

Frisse, M. E., & Metzger, J. (2005). Information Technology in the Rural Setting: Challenges and More Challenges. *Journal of the Medical Informatics Association*, 12, 99-100.

Fulk, J., Schmitz, J., & Steinfield, C. (1990). A social influence model of technology use. In J. Fulk & C. Steinfield (Eds.), *Organizations and communication technology* (pp. 117-140). Newbury Park, CA: Sage.

Furuno, J. P., Schweizer, M. L., McGregor, J. C., & Perencevich, E. N. (2008). Economics of infection control surveillance technology: Cost-effective or just cost? *American Journal of Infection Control*, 36(3 Supplement), S12-S17.

Garton, L. & Wellman, B. (1995). Social impacts of electronic mail in organizations: A review of the research literature. *Communication Yearbook* 18:434-453.

- George, D. & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update (4th ed.)*. Boston: Allyn & Bacon.
- Grant, R. W., Campbell, E. G., Gruen, R. L., Ferris, T. G., & Blumenthal, D. (2006). Prevalence of basic information technology use by U.S. physicians. *Journal of General Internal Medicine*, 21, 1150-1155.
- Greene, J., Caracelli, V., & Grahma, W. (1989). Toward a conceptual framework for mixed methods designs. *Educational Evaluation and Policy Analysis. Educational Evaluation and Policy Analysis*, 11, 255-274.
- Gruber-Baldini, A. L., Boustani, M., Sloane, P. D., & Zimmerman, S. (2004). Behavioral symptoms in residential care/assisted living facilities: Prevalence, Risk Factors, and Medication Management. *Journal of the American Geriatrics Society*, 52, 1610-1617.
- Hakes, B., & Whittington, J. (2008). Assessing the Impact of an Electronic Medical Record on Nurse Documentation Time. *CIN: Computers, Informatics, Nursing*, 26, 234-241.
- Haley, W. E., Levine, E. G., Brown, S. L., Berry, J. W., & Hughes, G. H. (1987). Psychological, social, and health consequences of caring for a relative with senile dementia. *Journal of the American Geriatric Society*, 35, 405-411.
- Handy, J., Hunter, I., & Whiddett, R. (2001). User Acceptance of Inter-Organization Electronic Medical Records. *Health Informatics Journal*, 7, 103-107.
- Haythornthwaite, C. (2002). Strong, weak, and latent ties and the impact of new media. *The Information Society*, 18:385-401.
- Hayrinen, K., Saranto, K., & Nykanen, P. (2008). Definition, structure, content, use and impacts of electronic health records: A review of the research literature. *International Journal of Medical Informatics*, 77, 291-304.
- Health Resources and Services Administration (HRSA). (2007). *The registered nurse population*.
- Hegney, D., Eley, R., Buikstra, E., Fallon, T., Soar, J., & Gilmore, V. (2006). *Australian nurses access and attitudes to information technology: A national survey*. Paper presented at the Consumer-Centered Computer-Supported Care for Health People, Seoul, Korea.
- Hersh, W. (2004) Health care information technology: Progress and barriers. *Journal of the American Medical Association*, 292:2273-2274.

Hillestad, R., Bigelow, J., Bower, A., Giroso, F., Meili, R., Scoville, R., et al. (2005). Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, And Costs. *Health Affairs*, 24, 1103-1117.

Hoagwood, K., Jensen, P. S., Feil, M., & et, a. (2002). Medication Management of Stimulants in Pediatric Practice Settings: A National Perspective, Child and Adolescent Psychiatry. *Year Book of Psychiatry & Applied Mental Health*, 49-50.

Holden, R. J., & Karsh, B. T. (2009). The technology acceptance model: Its past and its future in health care. . *Journal of Biomedical Informatics*, in press.

Ibarra, H., & Andrews, S. B. (1993). Power, social influence, and sense making: Effects of network centrality and proximity on employee perception. *Administrative Science Quarterly*, 38, 277-303.

Institute of Medicine. (2001). *Crossing the Quality Chasm: A new system for 21st century health care*. Washington, D.C.: National Academy Press.

ISO/DTR 20514. (2004). *Health Informatics – Electronic Health Record – Definition, Scope and Context* Retrieved. from.

Jacobs, B. (2007). Electronic medical record, error detection, and error reduction: A pediatric critical care perspective. *Pediatric Critical Care Medicine*, 8, S17-S20.

Johnson, D., Pan, E., Middleton, B., Walker, J., & Bates, D. W. (2003). *The value of computerized provider order entry in ambulatory settings*. Paper presented at the Center for Information Technology Leadership Boston, MA.

Joos, D., Chen, Q., Jirjis, J., & Johnson, K. B. (2006). An electronic medical record in primary care. *AMIA 2006 Symposium Proceedings*, 394-398.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly*, 23, 183-213.

Kawachi, I., & Berkma, L. F. (2001). Social ties and mental health. *Journal of Urban Health*, 78, 458-467.

Kazley, A. S., & Ozcan, Y. A. (2008). Do hospitals with electronic medical records (EMRs) provide higher quality care? *Medical Care Research and Review*, 65, 496-513.

Keating, N. L., Ayanian, J. Z., Cleary, P. D., & Marsen, P. V. (2007). Factor affecting influential discussions among physicians: A social network analysis of a primary care practice. *Journal of General Internal Medicine*, 22, 794-798.

Kelleher, K. (1982). Changing Course. *Nursing* , 85, 104.

Kijsanayotin, B., Pannarunothai, S., & Speedie, S. (2009). Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International Journal of Medical Informatics*, 78, 404-416.

Kimbler, M. B., & Peterson, G. M. (2006). Telepharmacy – Enabling Technology to Provide Quality Pharmacy Services in Rural and Remote Communities. *Journal of Pharmacy Practice*, 36, 128-133.

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (Eds.). (2000). *To Err Is Human*. Washington, D.C.: National Academy Press.

Kozloff, R. (1987). Networks of social support and the outcomes from severe head injury. *Journal of Head Trauma Rehabilitation*, 2, 14-23.

Krackhardt, D. (1990). Assessing the political landscape: Structure, cognition and power in organization. *Administrative Science Quarterly*, 35, 342-369.

Kuo, G. M., Dolan Mullen, P., McQueen, A., Swank, P. R., & Rogers, J. C. M., MPH, Med. (2007). Cross-Sectional Comparison of Electronic and Paper Medical Records on Medication Counseling in Primary Care Clinics: A Southern Primary-care Urban Research Network (SPUR-Net) Study. *The Journal of the American Board of Family Medicine*, 20, 164-173.

Lærum, H., Karlsen, T. H., & Faxvaag, A. (2004). Use of and attitudes to a hospital information system by medical secretaries, nurses and physicians deprived of the paper-based medical record: a case report. *Medical Informatics and Decision Making*, 4.

Lauman, E. O., Mardin, P. V., & Presky, D. (1989). The Boundary Specification Problem in Network Analysis. In L. C. Freeman, D. R. White & A. K. Romney (Eds.), *Research Methods in Social Network Analysis*. Fairfax, VA: George Mason University Press.

Leape, L. L., Cullen, D. J., Clapp M.D., & et al. (1999). . Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA*, 282, 267-270.

Leape, L. L., D.J., C., Dempsey-Clapp, M., Burdick, E., Demonaco, H. J., Ives-Erickson, J., et al. (1999). Pharmacist participation on physician rounds and adverse drug events in the Intensive Care Unit. *JAMA*, 282, 267-270.

- Likourezos, A., Chalfin D.B., Murphy D.G., Sommer B., Darcy K., & S.J., D. (2004). Physician and nurse satisfaction with an electronic medical record system. *Journal of Emergency Medicine*, 27, 419-424.
- Linder, J. A., Ma, J., Bates, D. W., Middleton, B., & Stafford, R. S. (2007). Electronic health record use and quality of ambulatory care in the United States. *Archives of Internal Medicine*, 167, 1400-1405.
- Loomis, G.A., Ries, J.S., Saywell, R.M., & Thaakker, N.R. (2002). If electronic medical records are so great, why aren't family physicians using them? *The Journal of Family Practice*, 51:636-641.
- Lurie, S., Fogg, T., & Dozier, A. (2009). Social network analysis as a method of assessing medical-center culture; Three case studies. *Academy of Medicine*, 84, 1029-1035.
- Markus, M.L. (1994). Electronic mail as the medium of managerial choice. *Organization Science* 5:502-527.
- Mason, J. (2002). Qualitative interviewing: Asking, listening and interpreting. In T. May (Ed.), *Qualitative Research in Action* (pp. 224-241). London: Sage.
- Mathieson, K. (1991). Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. *Information systems research*, 2: 173-191.
- McCain, C. L. (2008). The Right Mix to Support Electronic Medical Record Training: Classroom Computer-Based Training and Blended Learning. *Journal for Nurses in Staff Development* 24, 151-154.
- McLane, S. (2005). Designing an EMR Planning Process Based on Staff Attitudes Toward and Opinions About Computers in Healthcare. *CIN: Computers, Informatics, Nursing*, 23, 85-92.
- McLorg, P. A. (1989). Influence of social network members and health care professionals on infant feeding practices of economically disadvantaged mothers. *Medical Anthropology*, 10, 265-278.
- Menachemi, N., & Brooks, R. G. (2006). Reviewing the Benefits and Costs of Electronic Health Records and Associated Patient Safety Technologies. *Journal of Medical System*, 30, 159-168.
- Middleton, B., Hammond, W. E., Brennan, P. F., & Cooper, G. F. (2004). Accelerating U.S. EHR adoption: How to get there from here. . *JAMIA*, 12, 13-19.

Moody, L. E., Slocumb, E., & Berg, B., Jackson, D. . (2004). Electronic health records documentation in nursing: Nurses' perceptions, attitudes and preferences. *CIN: Computers, Informatics, Nursing*, 22, 337-344.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2, 192-222.

Moreno, J. (1934). *Who shall survive?* New York: Beacon Press.

Nagle, L. M. (2007). Informatics: emerging concepts and issues. *Electronic Healthcare*, 5, 1-2.

Nair, H., Manchanda, P., & Bhatia, T. (2006). Asymmetric peer effects in physician prescription behavior: The role of opinion leaders: Stanford University Graduate School of Business.

National Health Expenditure Accounts. (2007). *NHE Projections 2008-2018, Forecast summary and selected tables*. Baltimore, MD: U.S. Department of Health & Human Services.

Neuendorf, K. A. (2002). *The content analysis guidebook*. Thousand Oaks, CA: Sage Publications.

O'Malley, A. J., & Marsen, P. V. (2008). The analysis of social networks. *Health Services and Outcomes Research Methodology*, 8, 222-269.

Orlikowski, W.J., & Yates, J. (1994). Genre repertoire: The structuring of communicative practices in organizations. *Administrative Science Quarterly* 39:541-574.

Overhage, J.M. (2005). Presentation of the Morris F. Collen Award to Clement J. McDonald, MD. *JAMIA*, 12: 241-244.

Parasuraman, S., Drake, B.H., & Zammuto, R.F. (1982). The effects of nursing care modalities and shift assignments on nurses' work experiences and job attitudes. *Nursing Research*, 31:364-367.

Parente, S. T., & McCullough, J. S. (2009). Health Information Technology and Patient Safety: Evidence from Panel Data. *Health Affairs*, 28, 357.

Pinkerton, K. (2006). *History Of Electronic Medical Records*. Retrieved May 12, 2010, from <http://ezinearticles.com/?History-Of-Electronic-Medical-Records&id=254240>

Prensy, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5).

- Probst, J. C., Laditka, S., Moore, C. G., Harun, N., & Powell, M. P. (2005). *Depression in Rural Populations: Prevalence, Effects on Life Quality and Treatment Seeking Behaviors*. Columbia, SC: South Carolina Rural Health Research Center.
- Raschke, R. A., Gollihare, B., Wunderlich, T. A., Guidry, J. R., Leibowitz, A. I., Peirce, J. C., et al. (1998). A computer alert system to prevent injury from adverse drug events. *JAMA*, 280, 1317-1320.
- Rice, R. E. (1993). *Influence of computer communication use and network structure on work networks*. Paper presented at the Sunbelt Social Network Conference, Tanepa.
- Riffe, D., Lacy, S., & Fico, F. G. (2005). *Analyzing media messages: Using quantitative content analysis in research*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Rogers, E. M. (1979). Network analysis of the diffusion of innovations. In P. W. Holland & S. Leinhardt (Eds.), *Perspectives on social network research*. New York: Academic Press.
- Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.
- Salancik, G. R., & Pfeffer, J. (1978). A social information process approach to job attitudes and task design. *Administrative Science Quarterly*, 23, 224-253.
- Sapp, A. L., Trentham-Dietz, A., Newcomb, P. A., Hampton, J. M., Moinpour, C. M., & Remington, R. L. (2003). Social networks and quality of life among female long-term colorectal cancer survivors. *Cancer*, 98, 1749-1758.
- Schoenman, J. A. (2007). *Small, stand-alone and struggling: The adoption of health information technology by rural hospitals* (No. Working Paper #2007-02). Bethesda, MD: The Walsh Center for Rural Health Analysis.
- Schoenman, J. A., Keeler, J., Moiduddin, A., & Hamin, B. J. (2006). Roadmap for the Adoption of Health Information Technology in Rural Communities. *Federal Office of Rural Health Policy*. Retrieved January 15, 2009, from http://www.ruralhealthresearch.org/topics/100000065/publications_date.php
- Schulmeister, L. (2005). Ten Simple Strategies to Prevent Chemotherapy Errors. *Clinical Journal of Oncology Nursing*, 9, 201-205.
- Scott, C. (2007). Networks and social capital: A relational approach to primary healthcare reform. *Health Research Policy and Systems*, 5, 9-17.

Scott, J. (2000). *Social Network analysis: A handbook* (2nd ed.). Thousand Oaks, CA: Sage.

Scott, J., Tallia, A., Crosson, J. C., Orzano, A. J., Stroebel, C., DiCicco-Bloom, B., et al. (2005). Social network analysis as an analytic tool for interaction patterns in primary care practices. *Annals of Family Medicine*, 3, 443-448.

Short, J., Williams, E & Christie, B. (1976). *The social psychology of telecommunications*. London: John Wiley & Sons.

Shortliffe, E. H. (2005). Strategic action in health information technology: Why the obvious has taken so long. *Health Affairs*, 24, 1222-1233.

Sidorov, J. (2006). It ain't necessarily so: The electronic health record and the unlikely prospect of reducing health care costs. *Health Affairs*, 25, 1079-1085.

Siracuse, M. V., & Sowell, J. G. (2008). Doctor of pharmacy students' use of personal digital assistants. *American Journal of Pharmaceutical Education*, 72(1), 1-7.

Sisko, A., Truffer, C., Smith, S., Seehan, S., Cylus, J., Poisal, J. A., et al. (2009). Health spending projections through 2018: Recession effects add uncertainty to the outlook. *Health Affairs*, 28, w346-w357.

Sittig, D. F., Kuperman, G. J., & Fiskio, J. (1999). Evaluating physician satisfaction regarding user interactions with an electronic medical record system. *Proceedings from AMIA Symposium*, 400-404.

Sliva, L. (2007). Post-positivist review of technology acceptance model. *Journal of the Association for Information Systems*, 8, 255-266.

Spencer, E., Swanson, T., Hueston, W. J., & Edberg, D. L. (1999). Tools to improve documentation of smoking status: Continuous quality improvement and electronic medical records. *Archives of Family Medicine*, 8, 18-22.

Straub, D., & Burton-Jones, A. (2007). Veni, Vidi, Vici: Breaking the TAM logjam. *Journal of the Association for Information Systems*, 8, 223-229.

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for information learner. *Review of Educational Research* 79, 625-649.

Stubenrauch, J. M. (2009). Health information technology: A HIT with nurses? *American Journal of Nursing*, 109, 17-18.

Talsma, A., Grady, P. A., Feetham, S., Heinrich, J., & Steinwachs, D. M. (2008). The Perfect Storm: Patient safety and nursing shortages within the context of health policy and evidence-based practice. *Nursing Research*, 57, S15-S21.

- Tang, P. C., Ash, J. S., Bates, D. W., Overhage, M. J., & Sands, D. Z. (2006). Personal Health Records: Definitions, Benefits, and Strategies for Overcoming Barriers to Adoption. *Journal of the American Medical Informatics Association* 13: 121–26.
- Tashakkori, A., & Teddlie, C. (Eds.). (2003). *Handbook of mixed methods in social and behavior research*. Thousand Oaks, CA: Sage.
- Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Person computing: Toward a conceptual model of utilization. *MIS Quarterly*, 15, 125-143.
- Triandis, H. C. (1977). *Interpersonal behavior*. Monterey, CA: Brooks/Cole.
- Tsai, J., & Bond, G. (2007). A comparison of electronic records to paper records in mental health centers. *International Journal for Quality in Health Care*.
- Tsai, J. & Bond, G. (2007). A comparison of electronic records to paper records in mental health centers. *Interactional Journal for Quality in Health Care*, 2007: 1-8.
- U.S. Department of Health and Human Services. (2004). *Nurse Population: National sample survey of registered nurses*.
- Valente, W., & Pumpuang, P. (2007). Identifying opinion leaders to promote behavior change. *Health Education & Behavior*, 34, 881-896.
- Venkatesh, B., Davis, F. D. & Morris, M. G. (2007). Dead or alive? The development, trajectory and future of technology adoption research. *Journal of the Association for Information Systems*, 8: 267-286.
- Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly*, 24, 115-139.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27, 425-478.
- Wager, K. A., Zoller, J. S., Soper, D. E., Smith, J. B., Waller, J. L., & Clark, F. C. (2008). Assessing physician and Nurse satisfaction with an ambulatory care EMR: One facility's approach. *International Journal of Healthcare Information Systems and Informatics*, 3, 63-73.
- Wang, S. J., Middleton, B., Prosser, L. A., Bardon, C. G., Spurr, C. D., Carchidi, P. J., et al. (2003). A cost-benefits analysis of electronic medical records in primary care. *American Journal of Medicine*, 114, 397-403.

West, E., Barron, D. N., Dowsett, J., & Netwon, J. N. (1999). Hierarchies and cliques in the social networks of health care professionals: implications for the design of dissemination strategies. *Social Sciences and Medicine*, 48, 633-646.

Wiley-Patton, S. & Malloy, A.D. (2004). Understanding healthcare Professionals' adoption and use of IT. Proceedings of the Tenth America Conference on Information Systems, New York, New York, August 2004: 179-183.

Whitten, P. (2006). Will we see data repositories for telehealth activity in the near future? *Journal of Telemedicine and Telecare*, 12, 65-71.

Whitten, P., Buis, L., & Mackert, M. (2007). Factors impacting providers' perceptions regarding a Midwestern university-based EMR. *Telemedicine and e-Health*, 13, 391-397.

Whitten, P., Holtz, B., Meyer, E., & Nazione, S. (2008). Why won't hospice providers use telehealth? Explaining slow adoption in home hospice care. *Journal of Telemedicine and Telecare*, 15, 187-190.

Wightman, T. L., Horste, I. A., Speckman-Randall, E., Stratton, L. A., & Barnett, L. D. (2008). *Health of Rural Michigan Profile Report: Health Trends and Resources 1990-2005*. Lansing, MI: Michigan Department of Community Health, Bureau of Health Policy.

Wills, M. J., El-Gaya, O. F., & Bennett, D. (2008). Examining healthcare professionals' acceptance of electronic medical records using UTAUT. *Issues in Information Systems*, 9, 396-402.

Wolfstadt, J. I., Gurwitz, J. H., Field, T. S., Lee, M., Kalkar, S., Wu, W., et al. (2008). The Effect of Computerized Physician Order Entry with Clinical Decision Support on the Rates of Adverse Drug Events: A Systematic Review. *Journal of General Internal Medicine*, 23, 451-458.

Wong, S. S. (2008). Judgments about knowledge importance: The roles of social referents and network structure. *Human Relations*, 61, 1565-1591.

Wu, R. C., Laporte, A., & Ungar, W. J. (2007). Cost-effectiveness of an electronic medication ordering and administration system in reducing adverse drug events. *Journal of Evaluation in Clinical Practice*, 13, 440-448.

Wu, R. C., & Straus, S. E. (2006). Evidence for handheld electronic medical records in improving care: A systematic review. *BMC Medical Informatics and Decision Making*, 6.

Yarbrough, A. K., & Smith, T. B. (2007). Technology acceptance among physicians. *Medical Care Research and Review*, 64, 650-672.

Yoo, K. H., Molis, W. E., Weaver, A. L., Jacobson, R. M., & Juhm, Y. J. (2007). The impact of electronic medical records on timeliness of diagnosis of asthma. *Journal of Asthma*, 44, 753-758.

Zhou, L., Soran, C. S., Jenter, C. A., Volk, L. A., Orav, E. J., Bates, D. W., et al. (2009). The Relationship between Electronic Health Record Use and Quality of Care over Time. *JAMIA*, 16, 457-464.

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