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Acceptance and Usage of Electronic Health Record Systems in Small Medical Practices

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Abstract

One of the objectives of the U.S. government has been the development of a nationwide health information infrastructure, including adoption and use of an electronic health records (EHR) system. However, a 2008 survey conducted by the National Center for Health Statistics indicated a 41.5% usage of the EHR system by physicians in office-based practices. The purpose of this study was to explore opinions and beliefs on the barriers to the diffusion of an ERH system using Q-methodology. Specifically, the research questions examined the subjectivity in the patterns of perspectives at the preadoption stage of the nonusers and at the postadoption stage of the users of an EHR system to facilitate effective diffusion. Data were collected by self-referred rank ordering of opinions on such barriers and facilitators. The results suggested that the postadoption barriers of time, change in work processes, and organizational factors were critical. Although the time barrier was common, barriers of organizational culture and change in work processes differed among typologies of perspectives at the postadoption stage. Preadoption barriers of finance, organizational culture, time, technology, and autonomy were critical. The typologies of perspectives diverged on critical barriers at the preadoptive stage. A customized solution of an in-house system and training is recommended for perspectives dealing with technical and organizational concerns and a web-based system for perspectives concerned with barriers of finance, technology, and organization. The social impact of tailoring solutions to personal viewpoints would result in the increased sharing of quality medical information for meaningful decision making.

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Dedication

This dissertation is dedicated to my mother who inspired me with her dedication and courage to overcome all adversity with determination and perseverance. She instilled the belief that education is an indestructible and invaluable wealth, just like a carving on a stone. Her mentorship led me to pursue my doctoral studies without any reservations for time or reward.

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Chapter 1: Introduction to the Study

Introduction

Healthcare is a very personal and valuable benefit for the rich or poor, educated or uneducated, and working or retired members of the community. Agarwal, Guodong, DesRoches, and Jha (2010) stated that, in 2009, one out of every six dollars that was spent in the U.S. was on healthcare. This number is higher than what other, developed nations spend. Even though the spending is higher, the quality of care for Americans is a concern. Dunbar, Watson, and Boudreau (2007) found an association between inferiority in the quality of record keeping and sharing of information for the approximate 100,000 preventable deaths. Simon et al. (2007) discussed the importance of using the electronic health record (EHR) as a health information technology (HIT) in harvesting the improved measures of quality in healthcare. EHR technology is expected to improve quality by reducing preventable errors such as test duplication, misread prescriptions, and miscommunication of results by standardizing clinical documentation.

Felt-Lisk, Johnson, Fleming, Shapiro, and Natzke (2009) referred to three key benefits that were evident in HIT. According to the authors, the benefits were increased use of guideline based care, increased monitoring, and decreased medication errors. HIT includes tools like electronic medical record (EMR) or EHR, which are believed to be advantageous in increasing the quality of care. Digitization of records with an EHR system provides the opportunity for decision makers to access consistent information for the provision of care (Agarwal et al., 2010). Increased access to consistent levels of information is considered to be one of the keys to improved quality and lowering the number of preventable deaths. Improvement is possible because it allows decision makers to use their time for actual clinical decisions and not to use their time in gathering prior or historical information. Tulu, Burkhard, and Horan (2006) discussed the importance of factors such as physician time and the physician and patient interaction; both ingredients are required for improved quality. One of the benefits expected from EHR system implementation is a positive influence on accessibility and communication of information for the quality of care.

Prior research (Bhattacherjee & Hikmet, 2008; Simon et al., 2007; Ford, Menachemi, & Phillips, 2006; Menachemi, 2006) has focused on the adoption of information systems in the medical environment. Agarwal et al. (2010) explained that a number of previous studies on HIT discussed the factors of adoption and usage from the perspective of (a) scope of the level of adoption, (b) adoption barriers, (c) quality factors, and (d) efficiency and financial performance. Furthermore, the research results discussed in previous studies were mixed on two important factors, the impact of information technology in the improvement of quality of health and benefits of process enhancement with the use of information technology systems (Agarwal et al., 2010). Agarwal et al. further stated there was a similar trend of mixed positives, insignificants, or negative results on financial performance measures through the use of HIT systems. The authors further indicated that studies that showed positive results tended to associate with early adopters and customized, homegrown, and specialized systems. Similarly, Millery and Kukafka (2010) discussed that the statistically significant results could be consequence of a narrow scope of the study. Additionally, the authors stated that the positive associations between factors of health information technology with quality of care could be affected by publication bias. Millery and Kukafka stated that 57% of the studies examining the impact of health IT on quality of healthcare elected to use a single site, frequently in a large hospital setting. In sum, the results of a number of studies assessing performance on financial and quality of healthcare were representative of the large hospital environment. Furthermore, these healthcare establishments were using homegrown customized systems. The high-priced systems are not suitable for the majority of providers in small medical practices. There is limited research available on commercial off-the-shelf solutions, which are more feasible for smaller establishments.

The scope and level of adoption have been the focus of a large number of research studies. Agarwal et al. (2010) examined a 2008 survey by the American Hospital Association that suggested only 1.7% hospitals had a comprehensive EHR system, whereas 7.6% had a basic one. The literature further stated that EHR adoption is at a relatively slow rate when compared to other developed nations by the U.S. physicians and hospitals (Agarwal et al., 2010; Simon et al., 2007). The data further supported the observation that larger hospitals or large physician practices have been adopting the EMR technologies at a higher rate than smaller hospitals and physician practices (Agarwal et al, 2010; Millery & Kukafka, 2010; Simon et al., 2006). Ford et al. (2006) noted that nearly 60% of physicians practice in groups with 10 or fewer doctors. The authors stated that significant numbers of medical service encounters for individuals take place in small practices, resulting in the generation of much data on patient history in ambulatory clinics. Ford et al. stated that the goal of universal EHR adoption by the year 2014 might be possible if the critical mass of physicians practicing in small and solo practices accepts EHR. Hsiao, Hing, Socey, and Cai (2011) estimated that, in 2011, a mere 57.0% of physicians used EHR in office-based practices in the United States.

A number of barriers have been attributed to the slow rate of adoption of EHR technology. They range from financial, organizational, user traits, technical attributes, and environmental factors (Agarwal et al., 2010; Sachs, 2005; Simon et al., 2006). Agarwal et al. (2010) expressed that the American Recovery and Reinvestment Act (ARRA) is addressing the cost issue by giving incentives of up to $20 billion to healthcare providers for adoption of an EHR system in their facilities. An additional $27 billion is expected to be paid to service providers as Medicare and Medicaid reimbursement incentives over the first 4 years of adoption starting in 2011 (Agarwal et al., 2010). Whether these incentives will be enough to increase the rate of adoption of EHR considerably in the coming years remains as a question. Hsiao et al. (2011) estimated that 52% of physicians in 2011 were intending to apply for incentives payments promised by Medicare or Medicaid for EHR, showing an increase of 26% from 2010.

Felt-Lisk et al. (2009) indicated that cost alone was not the top resistance factor. There were other factors, in addition to cost, that did have a significant influence in the adoption of EHR. In the context of clinical practice, task compatibilities with the information system were important for the continued use of the system. Agarwal et al. (2010) explained that medical professionals differ in technology capabilities and financial constraints, suggesting there was subjectivity in decisions about cost, technology interface, technology functionality, and technical support. Tulu et al. (2006) deliberated on the adoption indicator named compatibility, technology’s compatibility with the overall work system in a medical setting. The authors stated that this indicator determined the behavioral intention of continued use of an information system. The authors concluded that the contextual meshing and compatibility of the technology with tasks and work practices of the medical office influenced the continued use of the systems. Hennington and Janz (2007) considered a combination of technology acceptance elements into a model for an individual's acceptance of a technology in the domain of the medical professional. These elements were the return on EMR investment, potential to improve quality of care with the technology, ease of use of EMR, and process change effort. The authors emphasized on managing the change with work practices for a continued use of the EMR system.

The other factors that drew attention on this issue were the technical capabilities of the current systems, work-flow adjustments, and lack of the culture for innovation and change within the organization (Simon et al., 2007). Ford et al. (2006) embraced diffusion theory model to empirically model the internal and external influencing factors affecting the rate of diffusion of a new technology. The empirical model predicted the rate of adoption of EHR technologies by the healthcare industry. The external and internal influencing factors relate with the potential adopter's social system. The external factors or innovation factors are driven by information from a source outside of the potential adopter's social system, whereas the information within the adopter's social system helps decisions on adoption and acceptance of the technology. The internal factors are social contagions. Ford et al. explained that the coefficient or the multiplier value for external factors affecting the rate of diffusion for the EHR system when compared to the medical equipment technologies like tomography, ultrasound imaging, and mammography was larger, but it was smaller when compared to consumer electronics, such as computers or calculators. Government mandates and public policies are examples of external influences. The medical equipment technologies diffused quickly, with smaller external coefficients, as they did not have to deal with heavy government mandates. U.S. medical providers negatively respond to mandated reporting, thereby resulting in high external coefficient for EHR technology. The authors further stated that the tipping point in EHR adoption may be qualitatively different than for consumer electronics. Ford et al. found that the internal factors influencing the adoption of EHR had lower coefficients when compared to readily accepted technologies. The authors suggested increasing the internal or social contagion factors such as interactive educational strategies among physicians in small practices to influence diffusion.

Much research is needed to provide guidance to healthcare professionals in the area of implementation of technologies like the EHR system, especially when they are not affiliated with a large organization. Agarwal et al. (2010) explained that not only was the structure, command, and control different between healthcare organizations of differing scope and size, the qualities of individual's traits were quite distinct and marked. Furthermore, relatively few relationships among EHR adoption factors were known. Additionally, qualitative and survey studies were instrumental in providing the knowledge on the factors influencing EHR technologies. Boonstra and Broekhuis (2010) expressed that literature was available on the suggested barriers of EHR adoption, but it lacked a systematic overview or generalized analysis on addressing the barriers. Different barriers or underlying factors have a different value for medical professionals in relation to the work environment setting and personal traits.

In sum, factors like financial cost, system features, technical support, work-flow alignment, and patient and physician interaction affect the diffusion of a HIT technology;

other factors like government mandates, partnership with vendors, social network within the medical domain also influence the adoption of the systems (Agarwal et al., 2010; Hennington & Janz, 2007; Ford et al., 2006; Tulu et al., 2006). There is a gap in literature regarding an understanding on how physicians working in small practices perceive EHR technology barriers. Furthermore, there were not many simple, specific, and concrete steps available to them to integrate EHR into their environment of limited resources. The purpose of the current study was to explore the subjectivity of perceptions for the barriers of diffusion in EHR adoption, especially in the context of small medical practices in the United States. The investigation focused on learning the patterns of beliefs among small practices (up to five physicians) on how to overcome the barriers of EHR adoption.

Problem Statement

The problem driving this study was to address the lack of understanding in the patterns of perceptions of practicing physicians with regard to the barriers to adoption and usage of EHR technology, especially in small self-owned practices. Lazard, Capdevila, and Roberts (2011) explained that the positions taken up by the concerned individuals in relation to an issue are neither singular nor unique to an individual; rather they are expressions of ordered patterns of cultural understanding. A discussion of one size fits all curative steps to overcome barriers to adoption of EHR does not provide the rich understanding on the range of efficiencies required in an integral format for a small medical practice. This study explored the subjectivity in the attitudes of physicians toward the impact of various barriers on the phenomenon of EHR adoption and usage.

The investigation focused on getting a thorough and systematic organization of opinions and beliefs on adoption and diffusion of EHR technologies. The analysis yielded categories of physicians that were identified based on similar and dissimilar viewpoints on the barriers and facilitators of EHR adoption and diffusion. The typologies resulted from the rank loading of statements describing such beliefs and opinions in correlation with each other. The ranking of the factors based on the subjective experiences and views of the physicians resulted in a more holistic understanding of the issue.

The experiences intrinsic to an individual physician characterized the patterns of perspectives on technology diffusion. A single ranking of important attributes does not provide a rich understanding in selection and customization of processes critical for successful implementation of EHR. An analysis of subjectivity in the attributes of adoption provided users with the ability to tease out their own priority ranking, thus help develop a realistic game plan. Proactive planning is expected to further reduce uncertainty in the EHR usage decision.

Q-methodology assisted the study to elicit subjective opinions and values, including both expected and counterintuitive self-referent accounts maintained by the professionals with respect to issues of EHR adoption and usage. Ellingsen, Storksen, and Stephens (2010) supported Q methodology in the development of new knowledge. It facilitated gaining an understanding of human subjectivity with the use of a quantitative dimension in the data-collection and data-analysis phase of the research process. The theoretical structure for EHR system adoption and usage applied the paradigmatic constructs of Rogers' (2003) diffusion theory of innovation (DTI) and the subset of constructs based on technology acceptance model (TAM, Davis, Bagozzi, & Warshaw, 1989). The constructs used in this study included determinants like relative advantage, compatibility, complexity, and personal innovativeness in the domain of information technology in small physician practices (Yi, Jackson, Park, & Probst, 2006). The attitude to accept an innovation, idea, or a technology in other professional domains is evidenced by perceived diffusion and acceptance characteristics given by two theoretical frameworks.

Nature of the Study

A combination of attributes of the Rogers' (2003) DTI and Davis et al.'s (1989) TAM using Q-methodology developed the typology of characteristics for adoption of EHR technology. The characteristics of the models included attributes of the organization, technology, and personal traits of the individuals working with the system. Q-methodology's ability to add rigor in the determination of correlation between people with certain traits or items provided the emergent themes for comparison. The ability to measure the magnitude of association among respondents' points of view shaped the factors generated with the statistical analysis. A *factor* is defined as a condensed statement describing a construct or dimension of a relationship between a set of variables. Analyzed factors were resultant of the ranking of traits and items along with a combined score for each factor based on how it loaded on that trait (McKeown & Thomas, 1988). The individual physician's point of view was the foundation of this methodology, as each physician represented a different perspective and different association with the issues concerning the EHR adoptions. The underlying focus of this study was how physicians interpret the meaning associated to the attributes and rate them as a barrier. The linear correlations used *r* coefficients to determine the relationship among the perspectives of physicians. The rotational factor analysis using PQMethod 2.20 (Schmolck, 2011) software presented the perceptions into operant factors.

The ability to determine barriers that are relevant to an individual physician gives them the ability to deal with the uncertainty and risk of the adoption process. Optimizing the benefits or reducing the negative effect of technical, organizational, and personal trait barriers may result in effective adoption and usage of the system. Thus, the Q-methodology, a mixed-method approach, was appropriate for this investigation of the points of view among physicians. These different perceptions and the evidence they provide are described in Chapter 3.

One of the qualities of Q-methodology is that it has the ability to minimize the viewpoint of the researcher. This method highlights and accounts for the respondents' viewpoint (Amin, 2000). Amin (2000) stated that, even though the generalizability of results was limited in Q-methodology, it provided an exploratory understanding to uncover beliefs and teased subjectivity in the analysis of issues. McKeown and Thomas (1988) explained the distinctiveness of Q-methodology with respect to other methodologies as this methodology uses a framework that facilitates idea generation in an unrestricted environment even though it may not involve a theoretical framework in the beginning. Ellingsen et al. (2010) stated that Q-methodology uses quantitative instruments to study human subjectivity, thus making it an appropriate candidate for a mixed-methods approach.

A pure qualitative approach might be appropriate to bring a deeper understanding of perceptions and experiences of physicians in adoption and usage of EHR technology. Phenomenological research method was a possible candidate for its ability to investigate and determine common experiences about a phenomenon among various individuals who are affected by it (Creswell, 2007). Phenomenology is known to reduce the individuals' experiences into a description with universal essence (Creswell, 2007). One of the challenges with phenomenology was that the researcher's interpretation voiced the lived experiences of the study's subjects. An unbiased situation required bracketing off the researcher's own personal caricature of the data that were elicited from the participant, thus presenting the voice of the participant as accurately as possible without any bias and distortion (Creswell, 2007). Q-methodology was selected for its ability to validate self-referred information without the bias of the researcher's viewpoint in the interpretation of results or instrument used for data collection (McKeown & Thomas, 1988). Ernest (2011) explained that data analysis in Q-methodology is based on the interpretation of statistics with the use of qualitative framework. The qualitative framework explores the interrelated opinions, thus making it eligible as a mixed-method approach.

The results of the study highlighted the opinions, perceptions, and experiences of physicians in overcoming the barriers in adoption and usage of EHR technology. The ideas generated in a self-referent, unrestricted search of behaviors was communicable to others. It explained the beliefs correlated with different barriers in EHR technology acceptance and usage. The TAM framework provided insight into why individuals accept or reject an innovation (Seeman & Gibson, 2009). The DTI framework provided insight into the process of innovation over time among members of a social system (Rogers, 2003). The two models explain the competing attributes of human, social, political, and organizational factors related with adoption and diffusion of a technology. The trends and patterns in innovation, adoption, implementation, and assimilation were well explained with attributes of relative advantage, compatibility, complexity, and the perceived innovativeness of information technology use. The integrated framework of the two theoretical models using Q-methodology investigated the following research questions.

Research Questions

Data addressed the following research questions:

1. What subjective perceptions may help overcome the adoption barriers of EHR technology in small medical practices of up to five physicians?

2. What subjective perceptions may help overcome the postadoption barriers of EHR technology in small medical practices of up to five physicians?

3. How might physicians use the ranking of observed subjectivity to get empowered for a successful adoption and implementation of EHR

Purpose of the Study

The purpose of this study was to assess physician preferences related to barriers of EHR adoption and usage in small practices. A ranking of important factors relevant to physicians in smaller practices based on their own perceptions that would make adoption more meaningful was established, which, in turn, could influence the improvement in usage of these systems. The domain of medicine is served by highly educated and trained physicians who provide services in an industry described as highly divergent because of its patients' needs, third-party scrutiny, and regulatory policies. The services of these professionals are affected by decisions and policies of health insurance organizations, federal and state regulatory agencies, internal organizational structures, and personal traits of the professional. Millery and Kukafka (2010) explained that state-of-the-art health information technology has been diffused in high resource environment, such as academic centers and large hospitals. Kaushal et al. (2009) suggested that the dimension of imminent adopter when compared to users and nonusers differed for adoption decisions. The authors concluded that financial considerations were important to imminent adopters. There is a gap in research studies regarding the subjective nature of the impact of barriers and process to overcome the barriers for a successful implementation of the system in small practices. Understanding the typology of physician profiles in response to the perceptions for the traits (barriers and benefits) will provide a roadmap for small practices to adopt and use to their advantage.

Although previous studies have focused more on demonstrating that information systems were valuable and beneficial for enhancement of quality, research did not focus on the supporting details on when health information technology becomes beneficial and valuable (Millery & Kukafka, 2010). The subjective nature of the interactions between resources and the environment could reveal different social perspectives of EHR adoption and usage. The patterns that were revealed showed how different physicians associate their set of variables with EHR adoption.

Statistical application of correlation and rotational factor analysis studied the subjectivity on the issue of EHR adoption. This was followed by a discussion on tailoring the inventions to support human subjectivity in reducing barriers for the adoption of EHR systems. A concourse of factors within the context of EHR acceptance and assimilation in the domain of healthcare was used within the conceptual framework of the TAM (Davis et al., 1989) and Rogers' (2003) DTI. The investigation explored whether the salient factors of compatibility for one physician were the same as that of another physician. Similarly, the saliency of attributes like relative advantage, compatibility, complexity, and perceived intention to use the information technology was analyzed (Webler, Danielson, & Tuler, 2009).

Theoretical Framework

The theoretical framework that was used for this study was an integration of the TAM (Davis et al., 1989) and DTI (Rogers, 2003). The constructs of perceived usefulness and perceived ease of use from Davis et al.'s (1989) TAM were integrated with constructs of diffusion theory to understand the dynamics in EHR adoption factors. Situational resources, technological constraints, cognitive ability of the physician, and other personal traits are known to influence the messaging and other communication resulting in the adoption and usage of other types of technologies. Rogers' (2003) DTI stated that the decision to accept or reject an innovation is based on the perceived characteristics of the innovation and its relative advantage, compatibility, complexity, trialability, and observability. The behavioral intentions of accepting the new computer technology are influenced by the perceived usefulness (PU) and perceived ease of use (PEOU) of the technology as described by Davis et al.'s TAM. Furthermore, the extended diffusion models used the subconstructs of PU and PEOU to explain an innovation's attributes of relative advantage, complexity, (Yi et al., 2005). Thus, the integrated TAM and DTI theoretical framework used the four determinants of relative advantage, complexity, compatibility, and PIIT on adoption and usage behavior (Yi et al., 2005).

The perception of relative advantage and consistency to perform the activities and practices by an individual influences the level of certainty with which the innovation is accepted. Relative advantage is related to advantageous outcomes in economic, time, social prestige, or other social values. Rogers' (2003) DTI has linked the relative advantage factor of innovation to the attribute of perceived usefulness. Similarly, compatibility is linked to perceived usefulness. Compatibility even though it is empirically different from relative advantage is conceptually treated the same as relative advantage (Rogers, 2003). Yi et al. (2005) explained a new determinant called PIIT in recent studies. According to the authors, it was a direct determinant of PU and PEOU. PIIT is used to account for subjective norms and perceived behavioral control in diffusion studies. Financial costs and benefits, clinical tasks and administrative task compatibilities with the technical system, lack of demonstrable tangible benefits, lack of social network support, and training are some of the important barriers for physicians in the adoption of EHR technology (Kaushal et al., 2009; Simon et al., 2007; Yi et al., 2005). Because significant barriers to adoption and diffusion for EHR technology are not homogeneously experienced and perceived by all physicians in different conditions, the objective of this research was to find the subjective difference among physicians, especially in small practices.

Efficiencies with clinical tasks are desired outcomes for EHR adoption and usage. Task requirements and characteristics directly impact the utilization of a technological system. Task complexity is attributed to influence decisions of adoption and is also attributed to affect the PU and the PEOU. Davis et al.'s (1989) TAM model used external factors of the organizational culture and structure to affect PU and PEOU to study acceptance of a system (Jun & Quaddus, 2007). The integrated framework of TAM and DTI provided the foundation for this study to evaluate the pre- and postadoption and usage behavior of physicians in small practices. Q-methodology used the foundational attributes of relative advantage, complexity, compatibility, and PIIT to close the gap in research on perceived barriers by physicians in small medical practices. Characteristics related to physicians, technology, and organization provided the typology of subjective self-referring beliefs on adoption and usage of the EHR system.

Definitions

The definitions of the terms used in this study are as follows:

Computerized physician order entry: a process of electronic entry of physician's instructions for the treatment of patients, drug prescribing, and other types of orders (Felt-Lisk et al., 2009).

Concourse: An initial collection of items in Q-sample development (Dziopa & Ahern, 2011).

Correlation coefficient: A numerical measure of the degree of agreement between two sets of scores. It runs from +1 to -1; +1 indicates a full agreement, 0 no relationship, and -1 complete disagreement (Kline, 1994).

Diffusion: A process in which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003).

EMR: An electronic system with applications that manipulate or process any information for the purpose of coordinating healthcare and health-related services of an individual (Castillo, Martínez-Garcia, & Pulido, 2010).

Factor: A dimension or construct that is a condensed statement of the relationship between a set of variables (Kline, 1994).

Factor loadings: Correlations of variables with a factor (Kline, 1994).

Health-care informatics: A discipline that focuses on the acquisition, storage, and use of information in a specific setting or domain (Cantiello & Cortelyou-Ward, 2010; Hersh, 2009)

Information System: Systems of hardware and software capable of digital information storage, processing, and communication that can serve some organizational function and purpose (Mustonen-Ollila & Lyytinen, 2003).

Professional: members of "occupations with special power and prestige . . . [based on] special competence in esoteric bodies of knowledge linked to central needs and values of the social system" (Walter & Lopez, 2008, p. 207) used the description of a professional from the sociology literature. By this literature, accountants, financial analysts, lawyers, university professors, and physicians are considered professionals (Walter & Lopez, 2008).

P-set: A participant sample in a Q-study (Dziopa & Ahern, 2011).

Assumptions

The investigator of this study assumed that participants were honest and unrestricted with their responses during the Q-sort process. The investigation used quantitative analysis of descriptive data. The statements of beliefs and viewpoints on EHR adoption included in the Q-concourse presented critical diversity. These statements were retrieved from the peer-reviewed literature. The selected statements in the Q-concourse portrayed the integrated theoretical framework of DTI and TAM. The scientific literature, including qualitative and quantitative methods, was used to outline a number of factors as barriers for the diffusion process of the EHR technology among physicians. Prior research used separate epistemological assumptions in an environment of large hospitals or academic centers in determination of a number of common factors of barriers for EHR innovation.

Although there was no exploration or testing of any specific hypothesis in this investigation, the study used the data from Q-sorts to determine observable relationships among respondents' points of view, thus employing a postpositivist philosophy with critical realism. Furthermore, to avoid the investigator's personal operational working suppositions, an election of Q-methodology supported quantitative analysis to describe subjective behaviors of respondents within the context of the adoption of information and communication EHR technology. The data were descriptive and not confirmatory or deductive in nature.

Scope and Delimitations

The scope of the study included physicians in the Midwestern United States working for small-sized practices of up to five physicians. The EHR implementation requirements and ARRA incentives were the same across the states within the United States; physicians working in Midwestern states were a good representation of the physician population working in small health facilities servicing all across the United States. Respondents selected for the study were either in the process of selecting and adopting an EHR system or had implemented a system in the last 5 years. The patient to physician ratio was not a criterion used in selecting the respondents.

Limitations

The integrated theoretical framework using TAM and DTI could have some paradigmatic limitations because of the drawbacks associated with the foundational theory. The TAM (Davis et al., 1989) accounts for the behavioral elements; it uses an assumption that, when one forms an intention to act, it usually is free from any other constraints. TAM has not taken into account the direct role of external variables in acceptance of a technology (Jun & Quaddus, 2007). The constraints of time and organizational factors were not directly factored in the adopter's intention to act within TAM's framework. To overcome this drawback, the researcher used integrated constructs of TAM into DTI (Rogers, 2003). The impact of organizational factors on perceived attributes of diffusion is well supported.

The methodological approach selected for the study is tagged with some limitations. Q-methodology requires participants to make a forced choice with the Q-statements as some respondents of the study may have made such discrimination of an agreement or disagreement with the stated opinion on the issue only at the time of performing the Q-sort. They might not have really deliberated on some specific statements related to the issue prior to the Q-sort activity. Furthermore, the participants of the study did not come from a randomized or large-sized sample; therefore, generalization of results was not an outcome of this methodology (Amin, 2000; Dziopa & Ahern, 2011; Webler et al., 2009). Consequently, Q-methodology is not considered to be a good candidate for normative studies.

Q-study is advantageous when attempting to uncover different patterns of thought on an issue among affected individuals. Its purpose is not to see the numerical distribution within the study's population; hence, a large sample size was not consequential (Valenta & Wigger, 1997). Another advantage of a Q-study is the physical involvement of the participants in the study. They physically work with a sheet of paper or an application on the web, showing their opinions and views on an issue. Thus, the completed activity gives participants a sense of control and ownership of their own contribution to the study. The elements of control and ownership for the study's data add greater reliability to the data-collection process. Q-methodology is proposed as a robust technique to study issues on policy making and analysis of institutional behaviors, especially in gaining a better understanding of individuals' rationality and behavior (Day, 2008).

Significance

The results of this study added to the statistically analyzed descriptive knowledge base, especially in the area of diffusion of an innovation and technology acceptance within the domain of technology use in the medical environment. The results are presented in the context of EHR adoption and usage in small-sized practices in the healthcare system. This investigation focused on emphasizing how physicians perceived and attached meaning to the variables of cost, time, technology, organization, and change associated with information and communication technologies (ICT) in the healthcare industry. Small-sized practices are expected to use the results of this study to develop strategies of implementation better in anticipation of reducing the anxiety of barriers. Additionally, it would provide the opportunity for smaller operations to reap the benefits of incentives associated with the meaningful-use program campaigned by the Center for Medicare and Medicaid Service (CMS). The patterns of beliefs and attitudes of physicians laid the foundation for the implementation strategies in supplementing an effective diffusion and acceptance process.

Rogers (2003) described the efficacy of diffusion research as to explore and advance the salient behavior of individuals, organizations, and political parties for significant consequences. The diffusion and technology acceptance model is relevant in many other domains and disciplines. Diffusion research is of great interest to social scientists as it cuts across multiple disciplines and provides a meaningful platform for social change.

The effective management of the characteristics of innovation is critical to EHR implementation. Informed practitioners in small healthcare organizations are less averse to risks when factors important to them have been accounted for with a suitable intervention. Furthermore, informed planning might help small practices better utilize the incentives given by the CMS.

Summary

Agarwal et al. (2010) indicated that the Health Information Technology for Economic and Clinical Health Act of 2009 proposed a major national commitment in the implementation of HIT. One such initiative was EHR adoption by medical practitioners (Felt-Lisk et al., 2009). Changes from the initiative are expected in the next decade or two as medical information moves from paper to digital format for increased efficiency, reduced errors, and increased team-based participation in patient care (Westbrook et al., 2009). Physicians working in large and small medical establishments are key players in the movement of digitization and sharing of the clinical information. Despite the high expectations of the policy makers, the adoption and usage rates of EHR technology have been low. A number of barriers have kept the diffusion rate low. The barriers include high investment costs, high financial commitment for maintenance of the systems, time constraints, substantial change in work practices, professional autonomy, system standards, vendor support, and a greater need of technical and computer skills (Boonstra

& Broekhuis, 2010; Castillo et al., 2010). The majority of evidence about the benefits and barriers came from studies using large hospitals, academic centers, or other leading institutions. Many of the studies focused on institutions that were using home-grown systems (Felt-Lisk et al., 2009). There is a gap in research with regard to providing a clear understanding of how diffusion barriers are perceived by physicians in small practices. Furthermore, the earlier studies did not provide a clear understanding of implementation strategies aligned to the subjective perspectives of individual physicians. A Q-methodology using the mixed-epistemological assumptions supported the investigation of the physician-user viewpoints on perceptions and beliefs about factors affecting adoption and usage at the micro and macro levels of their environment.

The pre- and postadoption attributes using the theoretical framework of DTI and TAM are discussed in Chapter 2. The adaptations to these models are discussed to add context-related specificity to the theoretical paradigms. The Q-methodology chosen for the study is discussed in Chapter 3. A mixed-method approach explored the subjective perspectives using an experimental tool of Q-sort with data analysis in two distinct phases. The first phase included quantitative factor analysis, and the second phase included the qualitative interpretation of the statistics (Ernest, 2011). The quali-quantilogical analysis of data using three sequential statistical procedures of correlation matrix, factor analysis, and computation of factor scores is described in Chapter 4. The summary, conclusions, and recommendations of the study are presented and discussed in Chapter 5.

Chapter 2: Literature Review

Content of Review

This study examined how physicians in small practices respond to the innovations in clinical technology as a function of individual perceptions and subjective attitudes toward the phenomenon of EHR adoption and usage. The researcher addressed a systematic ranking of traits and characteristics of various barriers. The rating assigned by physicians on the beliefs and attitudes toward the barriers determined the typology of physician profiles. The patterns of similarities and dissimilarities in perspectives culminated into factors of adoption, which in turn guided the roadmap for implementation of interventions for minimization of risks. The ultimate objective was to increase diffusion of the EHR systems in the health industry.

Diffusion of an innovation, idea, or a new process is associated with successful adoption by its users. The prediction of user acceptance of a new technology and its usage behavior has been explained by various information technology adoption models. The new technology under consideration for this study was the EHR system. The study focused specifically on small practices with less than five physicians. Prior research studies have provided evidence on HIT's impact on the quality of care. The evidence suggested an impact for improved quality in three major areas: increased adherence to guideline based care, increased monitoring, and reduced medication errors (Felt-Lisk et al., 2009). Acceptance of EHR medical technology by physicians and ancillary staff is viewed as a catalyst to the success of an EHR network of medical information. Hennington and Janz (2007) indicated that user acceptance is integral to the management of an information system. A number of theoretical frameworks have provided insight into how individuals accept innovations and technology.

Yarbrough and Smith (2007) stated that beliefs about innovation ultimately influence attitudes. The authors further stated that the attitude is a determinant of intentions, which in turn dictated behavior for acceptance of the technology, a paradigm that prompted the model of technology acceptance (Yarbrough & Smith, 2007). Yi et al. (2006) described how beliefs and intentions are communicated using all types of messages and systems of communication in a social system. The outcome of the communication process helped in the diffusion of a new idea or technology. The DTI posited that the rate of adoption is affected by perceived attributes or characteristics of the innovation (Yi et al., 2006). The beliefs of relative advantage, compatibility, complexity, trialability, and observability influenced diffusion through communication via social channels by defining attitudes, which in turn determined the behavior for acceptance of the new idea or technology.

Health-care professionals have been continually challenged by the clinical information technology innovation. The healthcare providers, especially physicians, are continually assessing the benefits and costs of implementing EHR technology in their work environment. Although the adoption of EHR facilitators and barriers has been described in earlier studies, not many studies provided a distinct adoption preference among physicians in small practices, and neither did they determine how these preferences were related to usage of EHR in the future.

The present study examined how small physician offices could be motivated to adopt and use EHR systems through three distinct preferences:

1. The adoption and usage factors of an EHR system that would become the tipping point for diffusion in small physician practices.

2. Minimization of the effects of adoption barriers.

3. Increase of the participation in the incentive programs supported by the Health Information Technology for Economic and Clinical Health Act of 2009 of $27 billion for Medicare and Medicaid providers

The adoption and usage preferences elicited by this study might help avoid any misguided adoption campaigns. This in turn might result in higher participation in EHR acceptance for increased quality and lower costs.

Organization of the Review

DTI and TAM provided the underlying concept to carry the investigation for this study. Next, the parallels between DTI and TAM were discussed. The EHR innovation for healthcare organizations based on an integrated theoretical approach is analyzed in Chapter 2. The integrated frameworks of the two theories provided the basis to understand the differences in preadoption and postadoption preferences of physicians working in small-practice environment.

The dependent preadoption variable, the rate of adoption for the EHR innovation, used four independent attributes of relative advantage, complexity, compatibility, and PIIT as suggested by the review of the literature. The integrated diffusion framework took the postadoption constructs of PU and PEOU and the preadoption constructs of the DTI framework (Conrad, 2010). The literature thus far chiefly focused on illustrating the benefits of EHR technology use and mostly discussed the barriers that are inhibiting the adoption within the social system of hospitals and medical offices.

Strategy for Searching the Literature

The review of the literature investigated the constructs of technology acceptance and DTI for theoretical frameworks in the domain of medical healthcare. Scholarly books by original authors provided the conceptual and methodological framework for the study. Peer-reviewed journal articles provided further review of theories and applications. The researcher searched relevant databases systematically. These databases were ABI/INFORM, EBSCO, Medline, PsycINFO, PubMed, Sage Journals, and the Cochrane Library. The other sources for the literature review included ProQuest, National Center for Health Statistics, and the Institute of Medicine. The researcher completed the literature review of the articles published between the years 2004 and 2012.

The information search of various databases used keywords by themselves or in combination with each other. The list of keywords used independently or in combination was as follows: *EHR*, *electronic health record*, *EMR, electronic medical record*, *innovation*, *diffusion, barriers, acceptance, HIT, health information technology, small physician practices,* and *healthcare*. The search was limited to peer-reviewed articles in the English language. The analysis of articles specifically focused on EMR-, HER-, or HIT-related topics.

Background

An immediate access to critical and essential clinical data for quality decision making, irrespective of geographical location of the individual, is the vision behind the digitization of the medical information. Sharing of such information electronically irrespective of how the person has existed in the system is one of the expected goals of the healthcare provisions. The U.S. government is pushing the use of the EMR or EHR by the year 2014 (Morton & Wiedenbeck, 2010). Carayon, Smith, Hundt, Kuruchitttham, and Li (2009) discussed the role of HIT in automating clinical, financial, and administrative transactions to improve quality, prevent errors, and increase consumer confidence in the health system. The implementation of EHR with the push from federal and local governments has been underway for the past decade (Carayon et al., 2009).

The terms EHR and EMR have been used interchangeably in research studies. In its simplest definition, EHR and EMR are the digitized record of the patient health chart (Updegrove, 2009). Castillo et al. (2010) described the concept of an EHR. EHR is described as an electronic system with applications that manipulate or process any information for the purpose of coordinating healthcare and health-related services of an individual. Castillo et al. explained that systems like computerized physician prescription, computerized physician order system, EHR, electronic alerts, and automated decision support capture and manipulate clinical data for the same purpose. Sachs (2005) explained the concept of EMR and EHR more specifically. According to Sachs, EMR is a record that is in the doctor's office or a hospital, whereas EHR is the record that pulls information together from multiple providers of care as well as from the patient. The term EHR is used to reflect both scenarios, the comprehensive use or a subfunctional application that manipulated just the clinical health data.

Sharing information using ICT would result in benefits of higher quality at lower costs. The estimated savings might be substantial if the technology adoption and usage is successful. Ilie, Van Slyke, Parikh, and Courtney (2009) discussed the report from the U.S. Department of Health and Human Services, suggesting EHR technology might save up to $140 billion a year along with a reduction in deaths caused due to medication errors. Sachs (2005) suggested other savings that might result due to significant collaboration and consolidation among health providers and payers because of the digitization of the medical records after the year 2015. The vision of cost control by eliminating the redundancies and filling in the communication gap among different care-giving parties is an expected outcome with the use of ICT technology, such as an EHR. Adoption of EHR, computerized physician order system, and other health ICT may also add benefits if sustained in a team-care environment across organizational and geographical boundaries (Westbrook et al., 2009).

Sharing and accessibility of information between the caregiver and consumer have been legitimated for cost-controlled, participatory medical treatment. Sachs (2005) discussed the availability of information-technology-enabled clinical care, personalized medicine, and other point-of-care technologies resulting in faster treatment decisions. Imaging, testing, and advanced treatment protocols have given the ability to provide automated real-time information to incorporate evidence-based reliable care.

Advancement in clinical medicine has renewed the need for the effective delivery of sophisticated health services. The therapeutic advancements along with the need to participate actively in one's own treatment are today's patients' demands. The healthcare industry has been moving into an era where it needs to come up to par with technology usage when compared with other industries. Patients are demanding a higher level of personal involvement in their own care. Patients are expecting the same level of communication with their health provider as they enjoy with other modern-day services in banking, retailing, and other services. The capability to receive lab results, schedule appointments, request prescription refills, and other information from their physicians online or digitally is important to technology-savvy patients (Callan & DeShazo, 2007; Yarbrough & Smith, 2007). These services are not readily available to the mainstream yet. The small medical practices have been lagging to provide some of the sophisticated services to their patients. EHR systems have the capability to bring these enhanced services to the mainstream.

EHR systems are being considered as a solution for providing more consistent and coherent documentation for decision making within healthcare services. Physicians are the direct beneficiary of quality information shared with EHR systems. Although sharing of information has been the impetus for EHR adoption, communication interfaces needed flexible standards to achieve this exceptional goal (Boonstra & Broekhuis, 2010).

Technology to deliver health services is available in both in urban and remote areas, independent of the location, patient, and service provider. The technology available is not cheap. The need for digitization and communication of clinical information has come with an escalated price tag. The increase in cost is attributed to the lack of standardization of data-recording activities and processes. The constraints of EHR technology standardization are not limited to the United States. Westbrook et al. (2009) stated that the demand for sophisticated health service was not seen only in the United States, but also in other countries around the world. The challenge to meet this expectation has been to deliver sophisticated services at a sustainable cost.

The escalating costs for the services have simultaneously added trepidation to policy makers, managers, and consumers. Walter and Lopez (2008) explained how the spiraling healthcare cost of the current system has been a concern in the United States. Information technology is seen as a tool that may help manage these costs (Walter &

Lopez, 2008; Westbrook et al., 2009). Cost control is anticipated with effective management of limited resources through proper implementation and use of clinical information systems.

The forces of cost and competition came from factors at different levels. The United States healthcare system has been driven largely by the forces of the market-oriented economy. It has been a blend of public and private delivery systems. Edwards and Halawi (2007) described the United States healthcare system as a system of fragmented components. According to Edward and Halawi, the factors influencing the United States healthcare system were (a) the absence of central governance, (b) the access to consumers was dependent on their level of health insurance coverage, (c) the dynamics of the marketplace that might disadvantage some from receiving a care or service, (d) tort and health law that heavily influenced delivery of service by the health provider, (e) the existence of a multipayer system that resulted in a lack of standardization of an acceptable service level, and (f) the development of sophisticated technologies that might have increased the demand for such services.

Cost containment is the top-most priority with lawmakers, starting with the availability of consistent information as a starting point for such containment. The private and public delivery systems have been envisioning the installation of a network of EHRs in the next couple of years to provide consistent accessibility of information, a move in the direction of reducing redundancy to control cost in the health system. Although those in the healthcare industry understand the benefits of the EHR network, there has been a resistance among the front-line user group to accept the systems due to many barriers.

The previous research studies have accounted for these barriers at the system, organizational, and user levels.

The barriers to adoption of a new innovation, idea, or technology result from characteristics of the innovation itself, adopter, or environment. Tatnall (2009) explained that the chronicled responses from the users or adopters about the characteristics of an innovation determine the level of diffusion. The responses are a reaction to the involved processes of using the innovation by the intended user (Tatnall, 2009). The author further explained that decisions of accepting an innovation are based on a rationale of how it adds value or worth to the original state of affairs. Various adoption approaches and frameworks, such as the theory of reasoned action, theory of planned behavior, TAM, and theory of diffusion have demonstrated and studied the important factors that influence the diffusion and adoption of technologies specific to a domain (Tatnall, 2009).

Many existing theories and frameworks have explained the behavior of the user within a specific domain in which the technology is being adopted. Adoption frameworks that have worked well for other industries have had a limited success in the healthcare industry due to the uniqueness of the users' professional and educational background, autonomous decision making in routine services, and pervasiveness of nonlinear clinical work processes. Furthermore, it has been stated that information and communication technology could add more complexity in medical work because of its collaborative nature (Westbrook et al., 2009). ICT has its own set of constraints for small-sized medical practices within the domain of medicine.

The medical professionals possess unique characteristics due to the nature of work performed by them. The uniqueness of the profession is further accentuated by the fact that medical services are provided by one or multiple entities for a given instance of service. Involved entities or organizations come with their own set of variables, such as size and levels of structure. Parente and Van Horn (2006) studied the organizational factors associated with information technology adoption for large hospitals. The factors like hospital size, urban location, and environment involving a high level of competition were positively associated with higher level of information technology adoption. Furthermore, organizational factors, such as a culture for innovation and change, have been associated at significance for EHR adoption. Simon et al. (2007) associated other organizational factors like size, financial stability, and culture of quality with significance in the adoption of EHR.

Furthermore, several studies (Ilie, Van Slyke, Parikh, & Courtney, 2009; Nov & Ye, 2008) have previously shown a significant role of an individual's traits within organizations affecting decisions about the adoption of new technologies or ideas. The correlation between demographic factors and adoption decisions about a technology has also been explored in the past. Yarbrough and Smith (2007) stated that the demographic factors of the adopters do not have significant influence on intentions to adopt a technology, whereas the factor of organizational support has influenced the adoption intentions. Furthermore, Yarbrough and Smith suggested age and sex are not significant predictors of technology acceptance, but organizational characteristics of size and salaried or nonsalaried status of physicians were significantly related. Personal barriers of computer experience and familiarity with technology were predictors of the technology acceptance as well (Yarbrough & Smith, 2007).

Other research in EMR adoption suggested barriers like interruption to routine and traditional patterns of operation, system-specific issues, and lack of empirical evidence of benefits from the technology contributed to slow acceptance (Boonstra & Broekhuis, 2010; Castillo et al., 2010; Westbrook et al., 2009). Updegrove (2009) explained the relationship between adoption barriers and the complexity of standardizing the development and use of the EHR systems. EHR technical systems comprise a number of components that require complex integration and communication standards. Slow development of the technology standards due to diversity in the focus of the public and private sectors has been a barrier for adoption and future usage of the EHR.

Thus, prior research provided evidence that demographic characteristics do not significantly influence the adoption and usage of the EHR system, rather the organizational and personal characteristics of the physician influenced the adoption and usage decisions. Ilie et al. (2009) attributed personal beliefs to be influential in determining the intentions to adopt or use the technology. According to the authors, the Reinvestment and Recovery Act of 2009 might provide the needed push for the implementation of the EHR network. The ARRA could influence physicians to take a step forward on the road map of digitizing the records only if the architecture and other related components were acceptable for future success.

Although there have been many studies that have focused on EHR system implementation by determining the contributing factors that facilitated or impeded adoption of the systems, very few rank ordered the barrier or facilitator traits. It might be helpful in adoption and usage of these systems to consider the subjective perspectives of the adopters. Studies focusing on how an individual physician would rank order the traits related with the process of adoption and usage of EHR technology would provide a deeper understanding of the underlying ideology of similarities and differences in attitudes toward the barriers and facilitators. Undeniably, adoption and implementation of HIT have been multifaceted issues; the adoption of EMR is contingent on a wide range of complex issues dominating individual physician's beliefs.

The concern for policy makers and physicians is the amount of investment needed for this change. Furthermore, the investment comes before the savings. The spectrum of savings and benefits are possible only with the success of the complete system. Updegrove (2009) explained that the U.S. government's estimate on the costs of deployment and implementation of an EHR system were anywhere from $60 to $110 billion. The operating cost was estimated to be close to $20 billion to $35 billion per year. The rationale for implementation of an EHR network is based on the expected benefit of close to $50 billion to $100 billion per year, which is a multiple of two or three of the total costs of amortized investment and operations (Updegrove, 2009). One would expect that, with the knowledge of savings statistics, the stakeholders would propel to action, but instead, there has been resistance because of the implementation barriers.

The pace of EMR technology adoption in communication and exchange of health information among networks of caregivers has been ironically slow when compared to the pace of advancement in treatment protocols using different technical systems. Felt-Lisk et al. (2009) stated that small physician practices lagged behind large practices. The authors stated that a third of all practices in the United States have physicians in a solo or two-physician partnership environment. In late 2007, only 9% of practices with one to three physicians had an EMR system. Felt-Lisk et al. further stated that it was not just the cost that stopped small offices from implementing an EHR system, but it was a combination of cost and other factors. According to Felt-Lisk et al., the 2009 ARRA, the Health Information Technology for Economic and Clinical Health Act of 2009, might provide support through the financial incentives to encourage small practices to adopt EHR. The main concern for the success of EHR diffusion has been whether the financial incentives are enough or if more will be needed.

The diverse issues associated with the adoption and diffusion could be attributed to incentives, standardization and certification of software systems, agenda of owner organization, operational changes, and practitioner and staff attitudes. The researcher developed a typology of physician perspectives based on perceived barriers for adoption of EHR technology by employing Q-methodology. The categories of factors helped determine whether physicians in small offices could mesh their EHR system successfully into their environment. Clustering the perceptions of physicians based on the subjective rankings helped develop the interventional plans that may become instrumental in the customization of EHR adoption and usage.

TAM

Technology usage is either for personal or organizational purposes. A number of theoretical models have attempted to understand the user acceptance of new technologies. The TAM (Davis et al., 1989) has been the most recognized model that explains the underlying behavior of the user in the acceptance of systems in the information system literature. The behaviors of the users in the process of new technology acceptance were first explained by the 1989 model of technology acceptance developed by Davis et al. Davis et al. (1989) posited that behavioral intensions determine the usage of computers by entities. It further stated that behavioral intensions are jointly influenced by a person's attitude toward the usage of the system and its perceived usefulness. Behavioral intentions are an aggregation of attitude and PU. The relationship between attitudes and behavioral intentions represent, all else being the same, people form intensions of behaviors toward which they perceive positive effects. The voluntary or intentional use of technology by an individual is the foundational paradigm of the model (Yarbrough & Smith, 2007).

TAM is based on the principles of the theory of reasoned action (TRA). The TRA as stated by Ajzen and Fishbein (1980) paradigmatically maintains that beliefs influence attitudes. Attitudes factor into one's intentions, and intentions ultimately dictate behavior (Fagan, Neill, & Wooldridge, 2008; Yarbrough & Smith, 2007). Fagan et al. (2008) further discussed the differences between TAM and TRA; the common difference between the two is the factor of subjective norm, which is included in TRA along with the construct of attitude.

Davis et al.'s (1989) TAM stated that computer usage is determined by behavioral intentions. Intention to accept a technology is affected directly by attitude, and intentions in turn are affected by PU and PEOU. Yi, Jackson, Park, and Probst (2006) explained that attitude played the role of a mediator between beliefs and behavioral intentions. Attitude was considered as a weak mediator and thus was dropped as an attribute from the model (Yi et al., 2006).

Davis et al.' (1989) TAM is a well-accepted approach to understanding the behavioral intent for adoption and use of a technology. The model uses the constructs of PU, PEOU, and a resulting network of factors influencing the behavioral intention toward technology use (Tulu et al., 2006). PU was explained as a belief that a technology will enhance one's performance, and PEOU was explained as a belief that the technology could be put into effect with little effort. Karahanna, Agarwal, and Angst (2006) explained PU, drawing on involved outcomes associated with technology use, and PEOU, drawing on ease in the effort to use the technology, and that both had significant correlation with intentions. Thus, the authors agreed that TAM was a good model for predicting validity for both initial adoption and continued use of the information technology.

Diffusion of a technological system requires adoption and institutionalization in its social system. Jun and Quaddus (2007) explained the qualities of the attributes of TAM. According to the authors, PU assessed the extrinsic characteristic of technology and the efficiencies and effectiveness of the tasks. PEOU assessed the intrinsic characteristics of the technology, ease of learning, use, and flexibility of the technology's functional interface. They further concluded that PEOU contributed to the PU of the technology (Jun & Quaddus, 2007).

Physicians are not only processing the adoption of the EHR systems, but they are also processing the changes required to implement the systems for continued use. Seeman and Gibson (2009) discussed whether a traditional TAM explained the acceptance intentions for all individuals, no matter whether they were professionals or otherwise. The authors stated that, only in the past few years, researchers have begun to study factors specific to a particular profession or domain. According to Seeman and Gibson, TAM alone might not explain the complexity of technology acceptance for medical professionals; therefore, the theory of planned behavior (TPB) was advocated. The complexity to accept a technology was associated with high-skill specificity in medical education and training of the professionals and to the environment that is heavily politicized (Seeman & Gibson, 2009). According to Seeman and Gibson, TPB defined individuals' behaviors were motivated by their intentions, which in turn were influenced by their perceived control and attitude toward performance of the behavior. Furthermore, the TPB stated that the behavior was influenced by perceived social norms or pressure from revered members of the social system. Seeman and Gibson further stated that the attitude, subjective norms, and perceived behavioral control were positively related to physicians' planned and actual behavior about acceptance of EHR technology. The authors concluded that both the TPB and TAM have constructs that explain the acceptance behavior of EHR technology.

Researchers in the past differed about TAM framework being able to explain the behavior of acceptance and usage in different domains of innovation and thus recommended an integration of TAM with constructs of TPB or DTI. Yarbrough and Smith (2007) stated that TPB was more general than TAM and TAM was parsimoniously more predictive about information technology adoption behavior. Bhattacherjee and Hikmet (2008) argued that TAM has been a dominant theoretical model for adoption and usage of the technology. They explained that, even though there have been other tested extensions of this model such as TAM2 and the unified theory of acceptance and usage of technology (UTAUT), the original model is very robust in predicting information technology usage across a range of contextual situations (Bhattacherjee & Hikmet, 2008). General user attitudes toward usage could be determined collectively by PU and PEOU (Ghobakhloo, Zulkifli, & Aziz, 2010).

TAM's appropriateness as a framework for EHR adoption was further supported by Bhattacherjee and Hikmet (2008). The authors explained that not only the intentions of technology usage were mediated by attitude, but TAM associated a positive direct relationship between PU and intention to use information technology. This relationship was independent of any indirect effect mediated by attitude. For example, if a technology is perceived to have usefulness for work and would improve performance, then a personal negative attitude will not override the intention to use the information technology (Bhattacherjee & Hikmet, 2008. The physicians have to be unquestionably convinced of the PU of EHRs for an increased performance in their daily work to override their concerns for the other barriers.

TAM in Clinical Information Systems

The users for clinical information systems are the physicians, nurses, and other ancillary staff. TAM is considered to be a robust model to explain the behavioral elements of acceptance and usage; the PEOU is stated to capture the aggregated effects of a number of factors. Nov and Ye (2008) explained that PEOU was influenced by the characteristics of the technology on one hand and the difference in the personality traits of the users on the other hand. Nov and Ye described one such personality trait, the resistance to change, as a constraint in the acceptance of an innovation. New technologies required some form of change for an individual and the organization. Nov and Ye stated that resistance to change, a personality trait, had a significant influence on PEOU in the acceptance of a system. The magnitude of change drives the behavior of an individual. Significant changes require significant alteration of tasks. Nov and Ye concluded that domain-specific resistance to change was a determinant of PEOU of a technology. There are other factors that may be attributed to organizational influences and system characteristics.

TAM has been tight in predicting an individual's behavioral intentions in acceptance of a computer technology, but it does not address the organizational factors (Bhattacherjee & Hikmet, 2008). TAM's framework in the past has been used to learn more about the influence of organizational and system factors on adoption. Bhattacherjee and Hikmet (2008) studied the role of organizational support on information technology usage in the healthcare sector. Bhattacherjee and Hikmet demonstrated that salient factors of organizational infrastructure and technical support have an indirect influence on a user's intention to use information technology. According to the authors, infrastructure support shaped PU and technical support shaped PEOU. Tulu et al. (2006) explained that the clinical information system could be effective if they successfully meshed with broader work practices. In medical practices, the technology has to integrate with a physician's workplace and work routines easily. Therefore, the acceptance models need to explain PU and PEOU within the context of the work practice for increased rates of adoption and acceptance (Tulu et al., 2006).

There are other studies that have looked into personal traits and their effects on acceptance of a technology. Seeman and Gibson (2009) and Walter and Lopez (2008) discussed the differences in personal traits between physicians and other knowledge workers in information technology acceptance. The authors concluded that the differences are due to specialized training, autonomous practices, and professional work arrangements. Furthermore, Walter and Lopez concluded that the perceived threat to the professional autonomy of information technology had a significant negative effect on perceived usefulness. The attribute of personal autonomy has been viewed as a barrier in the adoption of an EHR and EMR system.

Furthermore, the relationship among personal traits, resistance to change and system characteristics, and functionality of the system was also studied. Walter and Lopez (2008) suggested that functionality alone is not enough, and by itself it does not relate to PU. Furthermore, work flow also has an implied effect on professional autonomy. Physicians have shown a great deal of concern for the work-flow compatibilities in their adoption and acceptance of the EHR. The implied autonomy change is a cited barrier.

The relevance of TAM in studying a number of different situations and contexts within the domain of medical technology is quite evident. Many research studies tested its validity with constructs of PU, PEOU, and extensions with organizational and system factors (Bhattacherjee & Hikmet, 2008; Walter & Lopez, 2008). This study used the constructs of PU and PEOU to understand the perspectives during factor analysis and the interpretation of factors.

DTI

Medical health services are delivered to the consumer through a set of domain-specific processes, procedures, policies, and practices. Many of these processes are being impacted by the current needs and past practices of the involved entities. It is suggested that there is a global need for the sophistication of services in the health system that is constrained by limited resources. The traditional practices needed improvement and innovation throughout the health system (Westbrook et al., 2009).

Over a period of time, a set of new expectations, needs, and constraints require that these processes be automated, improved, or renewed. Currently, the need to innovate healthcare with technology systems and processes has been recognized in the areas of physicians' operational tasks and sharing of information with electronic communication to reduce errors and improve the quality of health services. The EHR technology diffusion and adoption are expected to shape this objective in the medical domain (Castillo et al., 2010).

Rogers' (2003) provided the framework that discusses the communication of the message about the new idea resulting into a social change. The author stated that the social-change process alters the structure and functions of a social system. Rogers explained that invention, diffusion, and acceptance or rejection is the consequences of the social change. The diffusion model first appeared in 1962 and has been modified over next 4 decades (Rogers, 2003). Castillo et al. (2010) noted that diffusion model explained why some innovations spread faster than others (Castillo et al., 2010). Castillo, Martinez-Garcia, and Pulido (2010) explained the centrality of the diffusion studies has been the factors affecting the decisions to make full use of an innovation through an available course of action.

The five sets of factors that affect innovation adoption were listed by Mustonen-Ollila and Lyytinen (2003) as (a) innovation factors, (b) individual, (c), (d) environment, and (e) organizational. Thus, innovations and innovators bring their own set of characteristics to the environment that determines the success of an innovation's adoption and usage. These attributes are determined by the innovation's domain, innovation itself, and characteristics of the adopter (Castillo et al., 2010; Wainwright & Waring, 2007).

Mustonen-Ollila and Lyytinen (2003) stated that each factor has its own traits, thus resulting in 28 attributes.

Any new innovation has to be communicated to its users and interested entities. Wainwright and Waring (2007) expressed that the communication of a new idea, technology, or process in a social system over a period of time determines its usage and assimilation. The diffusion of an innovation requires interaction and communication among its users (Wainwright & Waring, 2007). The elements of a diffusion process are the innovation, the communication channels, time, and the social system (Jun & Quaddus, 2007). Previous research, according to Jun and Quaddus (2007) suggested that information is collected and synthesized about the innovation, resulting in materialization of perceptions about the innovation. Thus, adoption factors and diffusion elements both affect the process of adoption and future use of an innovation.

Rogers (2003) suggested that there is an inherent uncertainty with choosing the new idea or product. Therefore, the deciding unit initiates a decision process called an innovation-decision process. This process involves acquisition of knowledge, formation of an attitude toward the innovation, adoption or rejection of the innovation, implementation of the idea, and confirmation of the decision to accept the innovation. The innovation-decision process was explained with five stages, starting from the knowledge stage, where innovation gains attention of its prospective users; then the second stage of persuasion, where attitudes are formulated regarding the new innovation. The third stage following the persuasion stage is called the decision stage, where the knowledge of the attributes and attitudes related to either the acceptance or rejection of an innovation is shaped. The fourth stage is the implementation of the innovation followed by the last stage, the confirmation stage (Castillo et al., 2010; Wainwright & Waring, 2007; Rogers, 2003). Rogers stated that, although the five stages exist, they are hard to probe or touch on due to intrapersonal mental processes. Furthermore, the author suggested categorizing the five stages helped in simplifying the complex realty. Thus, an innovation's diffusion process is heavily governed by the sharing of information and forming different behaviors during the five listed phases (Rogers, 2003).

The innovation-decision process is dominated by information-seeking and information-processing activities. To reduce uncertainty, there is an increased interaction among the individuals and organizations, leading to discussions on attributes of the new idea or technology and related work practices within the social setup. Rogers (2003) explained the characteristics of an earlier knower of an innovation. The author characterized them as formally educated with greater exposure to mass media and interpersonal channels of communication with exposure to agent or agency of change and socially with a higher level of participation and status (Rogers, 2003). Jun and Quaddus (2007) described this process as synthesis of knowledge by the individuals about the innovation based on the perceived characteristics of relative advantage, compatibility, complexity, trialability, and observability of the innovation.

Not only does the innovation-decision process involve synthesis of knowledge about perceived attributes, it requires change. Research has previously stated that there are positive relationships between work practice changes and diffusion of innovation (Westbrook et al., 2009). Jun and Quaddus (2007) explained that initial adoption and use does not always bring the complete benefits of the innovation. To maximize the benefits, the end user has to institutionalize the innovation by integrating it into daily work practices (Jun & Quaddus, 2007). Information on both facilitators and barriers reduces the uncertainty associated with the new idea, technology, or process. Rogers (2003) explained that innovations face the challenge of planning and managing. Furthermore, the author stated that both the invention and the inventor are vulnerable.

Rogers (2003) stated that an innovation's success depends on how well its users are willing to accept it. Institutionalization of the innovation by the user is important for the diffusion. The diffusion process involves the use of social channels among social members over a period of time to assimilate the new idea. The assimilation results in a social change that is propagated by alteration in the structure and function of the system. Thus, the innovation system consists of individuals and the social group in which these individuals interact (Rogers, 2003).

According to Rogers (2003), the processes within the social and communication structure of the system are dependent on norms, opinion leadership, change agency, and decision hierarchies. The types of decisions classified with any innovation are independent choice or optional choice, consensus or collective, power enforced, and contingent. The DTI framework further identified five categories of adopters based on the user's innovativeness. They are innovators, adopters, early majority, late majority and laggards (Rogers, 2003; Wainwright & Waring, 2007). The categories of innovators, whether they are the first ones, innovators, or the last ones, laggards, are based on the rate at which they adopt a new innovation. The rate of adoption is the relative speed at which an innovation is adopted by members of the related social systems (Rogers, 2003; Wainwright & Waring, 2007).

Adoption and usage of an innovation technology is not new to any one domain. According to Rogers (2003), the scope of DTI studies has increased as DTI framework has been tested for its rigor and parsimonious characteristic in different domains of expertise. Determination of the variables using empirical generalization in different domains has been the focus of diffusion research. Rogers further stated that diverse studies have focused on the perceived attributes of innovation and its rate of adoption, adopter categories, diffusion networks, and change agent.

Rogers (2003) discussed that the rate of diffusion of an innovation is affected by perceived attributes of an innovation. The list of attributes of an innovation's diffusion is as follows: relative advantage, compatibility, complexity, trailability, and observability. Therefore, the independent variables of relative advantage, complexity, compatibility, trialability, and observability are analyzed against the dependent variable of the rate of innovation. Relative advantage is explained as the degree that the innovation is perceived to enhance a state when compared to its previous state. Compatibility is the perception of the degree consistency with which an innovation holds on to the current values and needs of the innovator. Complexity is the degree of difficulty to use the new idea or innovation. Trialability is the availability to try the innovation, and observability is the degree of exposure of the new idea to the adopter. Innovations that are perceived to have most relative advantage (economic reward is high with low risk) are adopted the most (Rogers, 2003; Yi et al., 2006). The other additional variables that have been tested with fundamentals of DTI were the nature of the communication channels used for diffusion, nature of the social system where diffusion was happening, and how change agents promoted the innovation (Rogers, 2003).

Furthermore, a number of studies have investigated system level variables as independent variables. These independent variables are social status, size, resources, communication channel behavior, and change agency's involvement in relation to the dependent variable of innovativeness of members of a social system (Rogers, 2003; Simon et al., 2006). Westbrook et al. (2009) explained that domains outside the health area demonstrated that collaborative cultures and freedom of information flow resulted in higher rates of innovation. As stated earlier, DTI framework has been used to explain innovation in different domains. There have been a number of adaptations to the diffusion theory to explain the domain specific interactions and dynamics. These are in the form of system variables such as resource availability, internal and external environmental politics, and professional attributes. The diffusion of EHR systems in the healthcare domain has dynamics that relate to how individual physicians interact with organizational and environmental factors. The review of literature provided a comparison of other adaptations of DTI theory that could provide the framework for healthcare technological diffusions specific to the industry's dynamics.

Adaptation Models of DTI

DTI has been tested and evaluated for determination of attributes of innovation adoption, implementation, and assimilation. Prior research studies (Baskerville & Pries-Heje, 2001; Kaushal et al., 2009; Walter & Lopez, 2008; Wainwright & Waring, 2007) have expanded the listed factors associated with the information technology adoption and implementation based on the domain area of the innovation. The ethical issues, starting from sharing of confidential patient information, all the way to political issues, such as higher benefits gained by third parties as compared to benefits received by physicians in the process of EHR adoption, have made researchers extend the traditional DTI framework. EHR technology innovation and diffusion brought forth the issue of how a traditional DTI framework may be adapted to study the patterns of diffusion of EHR in medical practices. The following studies described the adaptations relating to the specificities unique to the healthcare scenario. Some adapted models used attributes at the micro, mid, and macro levels, while others defined attributes at the user, organizational, and process levels.

Wainwright and Waring (2007) evaluated the traditional DTI research alongside process research at an organizational level. The authors explained that small healthcare organizations would benefit a great deal if a rigorous DTI framework rationalized with the following determinants: the ethical requirements of the medical practitioner; small business culture of independent self-employed physicians; diversity of medical treatment and patient types; and increasing dependence on advanced information, communication, and decision support technologies. Thus, Wainwright and Waring examined adaptations of DTI theory to explain complex issues related to diffusion of technologies in small healthcare organizations. The objective of their study was to suggest a framework that allowed an understanding of complex human, social, and political issues in association with the information and communication technology diffusion framework.

Baskerville and Pries-Heje (2001) proposed another adapted DTI framework based on organizational factors. They described three different models of innovation. They used the complementary model to define the analytical dimensions for the diffusion of innovation process. Their framework looked at diffusion at an organizational level. Competition and conflict elements in the diffusion process dominated the ecological view, whereas the consensus and the regulation element dominated the genealogical view. The ecological view was more at the micro level of the organization, especially to help understand the characteristics of innovation within similar populations. The genealogical view was more at the intermediate and macro levels to help understand the power dependency and network interaction in the organization. The ecological view was internal to the organization, whereas the genealogical view was more extraorganizational in nature (Baskerville & Pries-Heje, 2001). Understanding the perspectives of physicians at a micro level for adoption and usage did not align with the genealogical view; therefore, it was not of interest for this investigation.

The ecological and genealogical views were based on three models: interactive, linked-chain, and emerging innovation process. The interactive model operated on the philosophy that the innovation is due to technology push, need pull, or integration of both technology push and need pull. The linked-chain model added the knowledge element to the innovation process. The emerging innovation process model added the external shock element (shock from external agencies) to the DTI framework (Baskerville & Pries-Heje, 2001; Wainwright & Waring, 2007). Wainwright and Waring (2007) suggested that the ecological view may be a good candidate to use in studies for EHR policy development. It was representative of the struggles between the different healthcare entities working in a heavy politicized environment.

Mustonen-Ollila and Lyytinen (2003) introduced another adapted DTI framework. It incorporated 28 factors inclusive of user characteristics along with organizational and process factors. These factors were (a) innovation inclusive of attributes like relative advantage, ease of use, compatibility, visibility, trialability, price, problem solver, standard, and technological edge; (b) task inclusive of attributes like commercial advantage, user need recognition, and user resistance; (c) individual inclusive of attributes like own testing, learning by doing, own rules and control of own work, and network; (d) environmental inclusive of attributes like cultural values, technology infrastructure, and community norms; and (e) organizational inclusive of attributes like interpersonal network, peer networks, working teams, informal communication, technological experience, interdependence from others, opinion leader and change agents, adopter type, and management hierarchy. This was an expansion of Rogers' (2003) traditional diffusion framework and was rigorous enough to apply in the physician adoption of an electronic health record system at a microlevel (Wainwright & Waring, 2007). Mustonen-Ollila and Lyytinen's extended DTI framework explained the information system's adoption with rigor and logic; therefore, it offered the foundation for this study's investigation.

DTI in Clinical Information Systems

The extended models of DTI investigated a number of issues with information technology system diffusion. Baskerville and Pries-Heje's (2001) interactive model explained an information system's diffusion in the healthcare domain. The interactive model using the need-pull and technology-push represented a similar environment as one related to EHR adoption by physicians in small-sized practices. Health-care spiraling costs as recognized by the government have initiated the technology push, such as EHR systems throughout the medical community (Baskerville & Pries-Heje, 2001).

Although the EHR systems were being pushed, the physician or adopter community has found a number of barriers slowing the acceptance of the systems in the work environment. Research (Boonstra & Broekhuis 2010; Viswanath & Scamurra, 2007) enumerated these EHR adoption barriers and classified them into various categories. Viswanath and Scamurra (2007) discussed the broad categorization of barriers into three areas. According to the authors, the barriers for adoption fell under the description of financial or cost-benefit, psychosocial, and technological. The financial issues were designated as investment costs, return on investment, and future reimbursement revenue flows. The psychosocial issues, such as the need for control or autonomy, change required with adoption, change in hierarchical structures, and other interactions, were recognized both at the personal and organizational levels. The technological issues related to customization, integration with other systems, and system complexity was listed. Viswanath and Scamurra further stated that psychosocial issues have received the most attention in empirical studies followed by technical issues using the diffusion framework. Financial issues have received the least attention.

Each barrier in the above-mentioned categories is composed of a number of subcategories. Similarly, Boonstra and Broekhuis (2010) classified the adoption barriers. They categorized the barriers into eight categories with many subcategories based on common underlying problems. The individual categories were financial, technical, time, psychological, social, legal, organizational, and the change process. The categories developed by Boonstra and Broekhuis (2010) and Viswanath and Scammura (2007) had the financial, psychosocial, and technical issues in common. These barriers were also cited and included in the extended model of DTI proposed by Mustonen-Ollila and Lyytinen (2003).

Results of research studies using Rogers' (2003) diffusion framework reflected a lack of PU with an EHR system. Lack of PU was a consequence of direct or indirect effects of the assumed barriers, lack of positive financial impact and lack of PEOU due to limited organizational support for these systems (Viswanath & Scammura, 2007). The barrier of compatibility of the information system in relation to medical work practices has been a concern to many medical practitioners (Tulu et al., 2006). The consistency of the technology with the work styles of the physician as a user is important for continued use of the technical system (Tulu et al., 2006). Thus, information system design might be the reason for increased time commitment from the physician. Loss of productivity due to increased time taken to parse through various screens of the EHR system has been cited as one of the barriers. Boonstra and Broekhuis (2010) believed that financial, technical, and time factors had been frequently cited in the prior studies as barriers, thus they categorized them as primary barriers. The psychological, social, legal, organizational, and change barriers had not received the same focus from EHR adopters in prior research studies, thus Boonstra and Broekhuis considered them to be secondary in nature. According to the authors, the secondary barriers were more at a subconscious level. Furthermore, Boonstra and Broekhuis stated that primary barriers had more significance for small practices rather than for large practices and organizational and change barriers mediated the effect of other barriers.

EHR systems have different challenges for small practices than for large hospitals and physician practices. Simon et al. (2006) stated that organizational factors, such as number of physicians in a practice and affiliation with a hospital, helped the rate of adoption (Simon et al., 2006). Another conclusion about the organizational factor was that physician practices on their own influence the adoption rather than an external agency such as the state medical society or the quality-improvement group (Simon et al., 2006).

Kaushal et al. (2009) discussed that it is not the individual's demographics, such as gender, age, and years in practice that impacted the decisions of adoption between users, imminent users, or nonusers of EHR technology, but the traits of the individual and organization. EHR adoption is dependent on organizational and individual attributes. Kaushal et al. investigated the EHR diffusion based on the adopter type. The authors argued that the employees of large hospitals or academic centers were seen as imminent adopters, whereas owner physician practices were not in the same category. The use of EHR has been increasingly seen in urban academic and larger hospitals where the individual does not have to bear the brunt of the initial cost (Kaushal et al., 2009; Menachemi, 2006). Furthermore, the technological support is available in these larger settings from the experts in technical departments. Kaushal et al. further stated that imminent adopters are likely to have heavy patient volume and practicing in multiphysician practices. Solo practices are less likely to support these systems, thus owner-physicians are more in the category of nonusers than in the imminent adopter category (Kaushal et al., 2009; Menachemi, 2006). From the perspective of quality improvement, nonusers were less engaged in quality-improvement activities when compared to the users of the EHR system.

The imminent adopters of information technology showed a higher comfort level with computer and Internet use when compared to nonusers (Kaushal et al., 2009). Additionally, imminent adopters are more concerned with initial and ongoing maintenance costs and less concerned about security and privacy in comparison to nonusers and users. Kaushal et al. did not look into why imminent adopters were not as concerned about privacy and security.

Furthermore, Kaushal et al. (2009) stated that physician owners have been more conservative in adoption of the EHR system due to financial implications and concerns for both the practice and personal income. More owner-physicians belonged to the nonuser category. The study provided the characteristics that differentiated imminent adopters from nonusers and users and was especially helpful in learning the characteristics about small physician practices that are owned by one or two physicians. Kaushal et al.'s investigation helped in understanding the characteristics of adopter type, but it lacked demonstrability of correlation between financial incentives and perceived intention of EHR adoption and use among different types of adopters. Furthermore, there was not enough research available that discussed the significance of organizational factors in the rate of adoption for a small physician practice.

Many small practices have concerns at the organizational and intraorganizational level. Wainwright and Waring (2007) discussed the effect of policies on digitization of patient information and its impact at a macro level. The results of their study showed that the expectations between the two parties, policy maker and medical practitioner, were not well communicated. The users were not aware of policy-makers' agendas. The physicians reflected that they were not consulted for expectant changes. At the micro level, a lack of engagement by the users at individual- and task-level factors was evident.

An initiative proposed by the ARRA of 2009 has brought the EHR adoption to the forefront. Incentives from the CMS might provide the boost in adoption of the EHR system, although usage of the system is dependent on a number of task-level and organizational factors (Fortin & Zywiak, 2010). Menachemi (2006) explained that, according to diffusion theory, adoption comes in waves, and a critical mass encourages future adoption.

Literature and research reflected that the success of an EHR technology system is determined by the culture within the practice, behavior toward change, hierarchical structures suited for adjustment toward change, and work in team-based environments. Castillo et al. (2010) and Wainwright and Waring (2007) stated that there is a need to have formal and informal communication networks that could facilitate such decisions using different and subjective environmental variables. The social structure of the system, the domain-related structures, and organizational culture determine the aids or barriers of adoption (Castillo et al., 2010; Wainwright & Waring, 2007).

Integrated Conceptual Framework of TAM and DTI

A thorough review of literature revealed that TAM framework explained acceptance at an individual level, whereas DTI framework explained the future diffusion of an innovation using personal traits and organizational and system factors. The review further revealed that studies in the domain of information technology within the context of medicine used extended models of TAM and DTI to include domain-related variables. These extensions included elements from TRA, TPB, UTAUT, and DTI. Jun and Quaddus (2007) explained that DTI and TAM have been the foundational theories of many information technology acceptance and use studies. The DTI explained the diffusion process of an innovation, and TAM explained the relationship between user perception, attitudes, and beliefs to actual use of a technology (Jun & Quaddus, 2007).

The similarities between the two theories were discussed by Yi et al. (2006). According to Yi et al., both theories posited the view that adoption of an innovation is determined by its perceived attributes. TAM constructs of PU and PEOU are a subset of the perceived characteristics of the diffusion of an innovation. PU is similar to relative advantage and conceptually focused on how the user feels about the benefits of the innovation. The expected impact of an increased or effective performance due to adoption of a new technology or idea is related to the relative advantage factor of DTI and PU of TAM. PEOU is similar to the attribute of complexity in DTI. An innovation is used more if the perceived complexity is not threatening the user (Yi et al., 2006). Nov and Ye (2008) stated the two antecedents for PEOU are system characteristics and individual differences. System characteristics, such as compatibility and objective usability, of the system affect PEOU. Individual differences of computer self-efficacy and computer anxiety also affect PEOU.

The personal innovativeness in the domain of information technology is the willingness of the person to try new technologies, a variable that determines the acceptance of a new innovation. A number of studies investigated physicians' use of information technologies, such as personal digital assistant devices, communication through e-mail, and online disability evaluations, in relation to the degree of personal innovativeness. PIIT was a determinant of PU and PEOU (Yi et al., 2006). The early adopters were technically competent and found complexity of technology less of a threat than late adopters.

Thus, the cognitive factors of individual physicians in the adoption of EHR portray an integration of PU and PEOU in the form of the ability to manage patients' prior clinical history, drugs, and current plan of action in a timely fashion without spending unreasonable resources of increased time with data entry or searching through the repository of suggested protocols from a decision-support system. Beaudry and Pinsonneault (2010) described the tenets common to TAM, UTAUT, DTI, and the decomposed theory of planned behavior. According to Beaudry and Pinsonneault, these models defined the attributes to help predict the information technology use grounded in beliefs and perceptions of performance expectancy, compatibility, and relative advantage. These models captured the cognitive factors into the theoretical framework (Beaudry & Pinsonneault, 2010).

A similar integrated approach was taken by Tulu et al. (2006) to study the medical workflow compatibility in the diffusion of a medical information system. Medical workflow compatibility is defined as the effective flow of the medical procedure through the use of an information technology system. Tulu et al. investigated the correlation between work practice compatibility and behavioral intent of continued use of the medical technology. Tulu et al. (2006) explained the continued use of a medical information system with integrated elements of compatibility and TAM. The authors concluded that there is a significant association among the intention of continued use of medical information technology, PU, and PEOU. Furthermore, work practice compatibility is significantly associated with intent for the continued use of medical information technology. It is evident from previous studies that physicians have found compatibility with work practices to be a direct variable in the diffusion processes of EHR systems. The work practices are a synthesis of the following constructs: medical tasks, medical workflow, and medical professional needs (Tulu et al., 2006).

Nov and Ye (2008) discussed the factors of PEOU in relation to system characteristics. They found that PEOU is an antecedent to system characteristics such as compatibility and objective usability. At the individual level, PEOU has antecedence with traits of computer anxiety and computer self-efficacy. Nov and Ye summarized that the resistance to change contributed to the explanations of determinants of PEOU. The system characteristics of compatibility and objective usability are both considered to be augmented to PEOU within the framework of DTI. This investigation used the constructs of relative advantage, compatibility, complexity, and PIIT as they had antecedents of PU and PEOU included in them.

Q-Methodological Studies and Their Purpose

The dichotomous use of the qualitative or quantitative approach in designing a research study has been attributed to the type and role of the research question (Bryman, 2007). There has been criticism on differing fronts of the qualitative or quantitative approach for deficiencies related to the fitness of a design and reliability of the conclusions (Goulding, 2005). Gelo, Braakmann, and Benetka (2008) discussed the criticism associated with the quantitative approach. According to the authors, the criticism was related to psychological attributes being measured quantitatively rather than being empirically investigated. Additionally, the authors stated that some quantitative researchers adopt an improper definition of the measurement unit under observation. The quantitative method might include variables that encode information ambiguously, leading to a less meaningful theoretical interpretation; thus the issue of the ontology and variable's epistemology is sacrificed (Gelo et al., 2008). The authors further stated that the qualitative approach characterized the philosophy of phenomenology and hermeneutics.

Gelo et al. (2008) stated qualitative approaches explain and describe the constituents and characteristics of a phenomenon or an entity. They are inductive in nature. In addition, qualitative approaches are able to consider reality by understanding the behavior and culture of humans based on the groups being examined. This understanding of a smaller number of participants allows for an in-depth perspective of participants' frames of reference and worldviews in contrast to the quantitative approach's use of hypothesis testing. Gelo et al. explained that qualitative results are a discussion of evidence based on emerged themes. Additionally, the reader has to be convinced that the discussion is well grounded in the observed data without the researcher's or the interpreter's bias. Ellingsen, Storksen, and Stephens (2010) explained that the qualitative research method is criticized for its roughly defined, too impressionistic, and subjective technique, and at times it is influenced by the researcher's prior understandings and views. Gelo et al. explained that an integrated approach may be employed to minimize the limitation of one particular method. Thus, there has been a rise of new viewpoints that support integrative qualitative and quantitative perspectives for an empirical investigation. Ernest (2011) described Q-methodology as a mixed-method approach using a blend of qualitative and quantitative techniques to learn subjectivity in a cross-disciplinary field.

Q-methodology has its ability to analyze the subjective attitudes, beliefs, and experiences statistically. Q-methodology correlates the themes into factors that signify the shared similarities and dissimilarities among participants. Donner (2004) described

Q-methodology to be a valuable addition in the researcher's toolkit for studies in information and communication technology and development. The methodology provided a good tool to study behavior where it is difficult to use other forms of user research. The author recommended the use of Q-methodology to understand the behavior associated with use and gratification of an information technology. The author explained Q-methodology uses a process of sorting statements related to a specific issue or concept. The statements may have a different appeal to different participants based on careful reporting of their subjectivity or unique view (Donner, 2004).

Valenta and Wigger (1997) used this methodology to understand and categorize opinions of Chicago-area primary-care physicians and medical students about information technology acceptance or rejection in the healthcare workplace. Rozalia (2005) recommended Q-methodology as a research tool to understand interrelationships among a product and the buying behavior in marketing studies. Wingreen, LeRouge, and Blanton (2009) studied training preferences among information technology professionals and their relationship to desired information technology professional roles. The above use of Q-methodology in different types of studies in information technology suggested that researchers have an interest to understand the subjective preferences of individuals in technology usage, development, and implementation.

Relationship of the Proposed Study to Previous Research

A relatively large number of previous studies on EHR adoption and usage included a narrow scope of a single site and short time span. Case studies and survey methods were dominant methods of data collection and analysis. More studies investigated home-grown systems for enumeration of the issues of EHR adoption, especially in a larger hospital or an academic environment. Only 9% of the studies investigated commercial systems developed by vendors (Westbrook et al., 2009).

EHR acceptance and usage are complex issues requiring attention about multiple facets of the diffusion processes. EHR technology acceptance and usage is influenced by organizational factors like the size, number of physicians, salaried or nonsalaried professionals, location, and financial stability. The culture of innovativeness, quality focus, and computing capabilities of the individual were positively related to adoption and usage. The role of external agencies or organizations, such as medical societies and organizations like frog leap, did not have significant influence on adoption (Simon et al., 2007).

Financial, technical, and time barriers are commonly listed for issues of adoption. Simon et al. (2007) stated that organizational factors, such as startup and ongoing costs, productivity loss, lack of technical support, lack of uniform standards, and lack of computer skills, determine the rate of EHR adoption. Bhattacherjee and Hikmet (2008) discussed the role of organizational infrastructure and other forms of technical support that influences information technology adoption and usage within organizations. Bhattacherjee and Hikmet stated that the theoretical frameworks of TAM and UTAUT provide a strong explanation for personal-use information technology products or services but give a limited explanation of what organizational support systems can do to motivate organizational end users in utilizing the technology. The authors stated that a good understanding of organizational support factors on information technology usage may help formulate interventional strategies for enhancing information technology usage in the workplace and allocate resources in the management of these factors (Bhattacherjee & Hikmet, 2008).

Barriers that influenced EHR adoption are at the personal, organizational, and environmental levels. The eight categories of barriers distinguished into primary and secondary types were discussed by Boonstra and Broekhuis (2010). Furthermore, Boonstra et al. stated that the barriers among different categories and subcategories are interrelated. A technical barrier, such as computer skills, influenced the time factor. Increased time to learn the system causes financial loss because of lower productivity. Financial outcomes may be influenced by technical and time factors. The present investigation explored finding the interrelationships among these factors in relation to small practices.

Nov and Ye (2008) expressed that the resistance to change carries an explanatory power to personal characteristics, whereas system characteristics supports the understanding of the determinants of users' PEOU. Different users have different levels of resistance to change. Grouping individuals based on whether they are routine seeking, emotional reactors to change, with short-term focus, and cognitively rigid might help support higher levels of adoption.

Financial issues have been investigated from the perspective of adopter type. Menachemi (2006) summarized that previous studies examining the barriers to EHR adoption did not discriminate adoption behavior based on the type of the adopter. The studies discussed the barriers from a general perspective. The imminent EHR adopter may be influenced by the same barriers at the same significance level as the nonadopter or laggard leaves a gap in knowledgebase. Thus, there is a gap in research regarding how different barriers affect different types of adopters and adoption processes. Imminent adopters did not give pronounced weight to the initial cost or return on investment. Productivity-related elements and workflow disruptions were less important to imminent adopters (Menachemi, 2006).

Factors for information technology acceptance and usage showed that the characteristics of the technology, tendency to try new technology, interaction with factors internal and external to the organization, and cognitive skills are really influential. The objective of this study was to understand how attributes of innovation and acceptance are different for small-sized medical practices. Independent physicians face the challenge of integrating technology to maximize their professional potential. A Q-methodology study explored how physicians perceived the barriers of implementation and usage of EHR system.

The traditional qualitative and quantitative research methodologies have limitations when employed to study the subjectivity in factors that influence an adoption phenomenon. Dariel, Wharrad, and Windle (2010) explained that online surveys have been known to touch the surface of the underlying issue and sometimes favor respondents who were very familiar with the environment of the phenomenon under investigation. They tended to leave out respondents who were not very familiar with all facets of the issue. A number of research studies found the efficacy of Q-methodology to study the preferences of the individual about an issue.

Baker, Thompson, and Mannion (2006) discussed the efficacy of eliciting individual preferences for better understanding of human motivation and economic action in healthcare. The importance of preferences has interest in policy decisions as they help in understanding the association of the preferences with respect to opportunity cost and marginal utility of the resources. Rozalia (2005) studied Q-methodology and its applicability in marketing research especially in studies of consumer behavior. Rozalia discussed the use of Q-methodology in fields where a thorough understanding of psychometric knowledge is important. In the analysis of consumer behavior, a consumer might select a product from a product category based on price, simplicity of use, and uniqueness. The market researcher might be interested in knowing which of the three factors is of high importance to the consumer to strategize for future promotions.

McLean, Hurd, and Jensen (2005) explored the subjective ranking of the skills or competencies required by CEOs of a parks and recreation function in public administration. The subjective ranking of the competencies of CEOs in parks and recreation included the individual's personal experiences, background, education, and operation in different political structures. Additionally, the study sought to find commonality or differences among the CEO competencies. The competencies that loaded high among all the attributes provided the conclusion that CEOs were a product of their education and training experiences. Q-methodology is gaining a foothold as a quali-quantilogical methodology to analyze qualitative data systematically using statistical analysis.

Summary

The objective of this research study was to investigate how EHR adoption and usage were affected by various barriers and understand what role an individual physician's beliefs and perceptions played in the adoption of an EHR system. The TAM and DTI models suggested that the adoption of a technology was determined by its perceived attributes (Yi et al., 2005). This study used the theoretical construct of PU and PEOU as subconstructs for the attributes provided by innovation diffusion theory (Conrad, 2010; Tulu et al., 2006; Yi et al., 2006).

The motivation to accept and use EHR technology by physicians working in small practices depended on their own beliefs and experiences regarding the barriers and facilitators. Individuals adopt an innovation much more quickly by deciding for themselves, which is not the case with an organization (Rogers, 2003). It was evident from prior studies that there are many barriers to the adoption of EHR, both at individual and organizational levels. Furthermore, not all barriers may be critical to physicians in small practices, thus a Q-methodology would help demonstrate the patterns of subjectivity and the role they play in adoption and usage. Q-methodology is characterized with features that explain patterns in subjectivity, identify similarities and dissimilarities in views, and generate new ideas that could be tested as hypotheses (Webler et al., 2009). Chapter 3 describes the methodology in the context of the present study.

Chapter 3: Research Method

Method of Choice: Q-Methodology

The purpose of this Q-methodology study was to highlight how the physicians in a small-practice environment perceived factors that may advance adoption and usage of EHR. The barriers impacting the adoption and usage behavior of the users emerged from the literature review (Boonstra & Broekhuis, 2010; Castillo et al., 2010). Furthermore, Carayon et al., (2009) stated that small practices have limited resources. Many physicians share job responsibilities related to that of a clinician and that of a business manager. HIT use in their practices has a critical role. This study investigated the subjectivity associated with these critical adoption and usage barriers by physicians in smaller practices. The development of Q-concourse incorporated the viewpoints reflecting the barriers. The five barrier categories are

1. Financial.
2. Time.
3. Technology.
4. Organization.
5. Change.

Q-methodology helped study the clusters of physicians grouped according to their responses on perceived barriers in the adoption and usage of EHR technology, especially in their small-sized organizations. The clusters represented as factors were driven by the subjectivity in the individual's perception about the factors of relative advantage, complexity, compatibility, and perceived intention of information technology use influencing the five barriers.

The objective of the research was to provide measurable and context-rich results independent of the researcher's bias. The following questions led to the use of Q-methodology:

1. What subjective perceptions may help overcome the adoption barriers of EHR technology in small medical practices of up to three physicians?

2. What subjective perceptions may help overcome the postadoption barriers of EHR technology in small medical practices of up to three physicians?

3. How might physicians use the ranking of observed subjectivity to get empowered for a successful adoption and implementation of EHR?

This chapter elaborates on the research design and data-analysis processes involved in answering these research questions. A rationale for the selection and usage of Q-methodology is also included in this chapter.

Q-Methodology and EHR Technology Adoption and Usage

The acceptance or resistance in adopting EHR technologies in healthcare are attributed to physicians, their organizations, and government policy. The causes of resistance have been attributed to concerns about service-related issues of privacy and confidentiality of patient information, depersonalization of the patient-physician relationship, and overstandardization of healthcare. On a personal level, the resistance is related to the fear of revealing practitioners' technical skills ignorance, increased time consumption for tasks, autonomy shifts, and increased accountability (Boonstra & Broekhuis, 2010). There is so much diversity in these factors that it is not possible to figure out one composite average opinion. The formulation of interventions to minimize the resistance might be possible with a better understanding of the interrelationship among these factors with physicians. What meaning do physicians attach to barriers of EHR adoption and usage? Furthermore, the interventions might require customization based on the typology of perspectives dominated by influencing factors.

The justification for choosing Q-methodology, a type of mixed-method approach, was twofold. First, the methodology promised to provide intelligible and rigorous explanations of human subjectivity (McKeown & Thomas, 1988). Second, it allowed statistical analysis, revealing the subjectivity related with human issues. There have been different perspectives and opinions associated with financial costs, patient-physician communication, and workflow adjustments affecting the digitization of information in small medical practices.

This investigation explored the perspectives of medical practitioners who are contemplating adoption (imminent adopters) of an EMR system in their work environment and current users of the system for acceptance and diffusion. These perspectives resulted from personal viewpoint on perceived characteristics of relative advantage, complexity, compatibility, and personal innovativeness. The strategy behind using quali-quantitative analysis with Q was to reveal similar or dissimilar perceptions held by physicians based on the five attributes of diffusion. Relative advantage reflected economic rewards, patient-doctor communication, turnaround time, and quality of care (Conrad, 2010; Rao et al., 2011). Complexity observed in the form of workflow change, technology unfamiliarity, and issues of obsolescence (Boonstra & Broekhuis, 2010; Conrad, 2010; Ford et al., 2006; Rao et al., 2011; Tulu et al., 2006). Compatibility related to ease of use of the technical system and the related adjustment with work processes and work routines (Boonstra & Broekhuis, 2010; Nov & Ye, 2008; Tulu et al., 2006).

Personal innovativeness related to a culture advocating acceptability to try new tools, techniques, and technologies (Simon et al., 2011).

Relevance of Methodological Selection

Adoption and continued usage of an EHR system are complex issues. Factors that are involved operate at individual, organizational, system, and other macro policy levels dictated by external agencies. The study of complex issues requires a good understanding of human subjectivity. Amin (2000) discussed the relevance of Q-methodology for inquiry into the subjectivity of the human mind in understanding complex issues. The principle concepts of Q-methodology were explained by Stephenson (1955), the British physicist. Stephenson developed Q-methodology in the 1930s for the purpose of understanding the subjectivity of the human mind regarding different issues.

Subjectivity in healthcare is dominant in all aspects of medical interaction. The interactions happen at all levels: among physician, patient, employees, management, government policies, pharmacy, labs, and technology. The subjectivity of the variables has been explained from personal traits of physician, patient, technology characteristics, organizational factors, and environmental factors. Amin (2000) discussed the need for research on understanding the subjectivity in health services and its providers. The subjective issues in healthcare are not easily quantifiable, thus they required a research methodology that would qualitatively dig into the details working behind the different variables (Amin, 2000).

Adoption and diffusion researchers that study the healthcare system have investigated variables using both qualitative and quantitative methods. Williams, Dwivedi, Lal, and Schwarz (2009) discussed the use of different types of research methodology in the studies of adoption and diffusion in the information system domain. Williams et al. found that 68.4% of research studies used the quantitative approach compared to 22.6% that used the qualitative approach. Only 1.3% employed a mix of data types. Similarly, 57.5% used the survey research method, and 15.3% used a case-study method. Williams et al. argued that adoption and diffusion research could use alternative methodological perspectives. The positivist approach has been used to a greater extent than the descriptive and interpretive approach. Sayer (1992) explained that statistical analysis in a quantitative study evaluates the relationship between independent and dependent variables; it sometimes falls short of explaining the holistic structural relationships of an object or unit of analysis.

In reality, objects are not just transparent and simple. It is equally important to understand their qualitative feature by becoming familiar with their formal relations of similarity and dissimilarity. Sayer (1992) deliberated that statistical techniques common to the quantitative approach were often used to identify common and dissimilar properties. Any time this type of identification process is undertaken, quantitative and causal knowledge are used to narrow down the list of possible factors that might have relevance.

According to Amin (2000), Q-methodology had elements of both qualitative and quantitative research methodologies. It has been instrumental in the conversion of subjective data into quantifiable data. Q-methodology accounts for the viewpoints of different respondents unlike a quantitative study where the hypothesis under consideration reflects what the researcher wants to prove or disprove (Amin, 2000). Q-methodology is exploratory in nature and uses in-depth analysis to uncover opinions about the variables related to the study.

The qualitative method, such as phenomenology, could have been an alternative for this study but was rejected because it relied on competence of the participant to articulate his or her thoughts. Furthermore, it sometimes addresses issues that have received exposure and attention (Dariel et al., 2010). The analysis of data in phenomenology requires the researcher's ability to describe the essence of others' experiences. The description process is not very easy as it sometimes leads to additions of the researcher's personal interpretation of the viewpoint (Creswell, 2007).

Survey research was another potential method to collect and analyze the data. The reason for not employing the survey method was that the variables of the phenomenon are usually measured at a single point of time and data usually describe the distribution within the population for certain characteristics or features of high propensity. Therefore, the interpretation of data has more likelihood of incorporating the researcher's bias (Dariel et al., 2010; Singleton & Straits, 2010).

The investigation in this research used Q-methodology because the subjectivity of physicians' perception about various barriers was not discussed in any previous research. The individual's point of view is the foundation of Q-methodology, thus the methodology fulfilled the need for understanding the attitudes and perceptions about adoption and usage of EHR in small practices. The methodology posited that an individual's subjectivity is communicable to others and it advances from a point of self-reference (McKeown & Thomas, 1988). Q is based on the underlying principles of analyzing human opinion without the incurrence of the researcher or instrument bias during and after the data-gathering process. It gives the opportunity to the respondents to participate in expressing their opinions without having the researcher hypothesize it for them (Dziopa & Ahern, 2011; McKeown & Thomas, 1988). The analysis of the Q-sort is the only time when the researcher uses her own interpretation. Thus, the objective of this research was to find patterns of similarities and dissimilarities in the perceived motivation to adopt and use EHR technology by physicians in a smaller work environment. Consequently, the research methodology selected for this study was primarily qualitative with elements of quantitative analysis possible with Q-methodology.

Q-Methodology

Research iteratively adds to the current and available knowledge. Singleton and Straits (2010) discussed how scientific knowledge is tentative in nature. One of the characteristics of research is that scientists rarely achieve complete truth. Knowledge building has been characterized as emergent and iterative. The evidence used to build a scientific proposition is based on recurrence of an observable event. Singleton and Straits stated that observable events are open to change and reinterpretation. There is no guarantee that reoccurring events would continue to occur as before or behave as before. Thus, verifiable knowledge has to be explained and communicated clearly to others for traits of reliability and accuracy.

The creation of verifiable knowledge requires an appropriate design and structure for the research study. Maxwell (2005) described the relationship between the research question and research design. The author stated that the research question is the hub of the research design and connected all other components, such as a theoretical framework, research method, and research goals. The interrelationship between the research question, theoretical framework, data-collection method, result expectation, and result utilization unmistakably need unambiguousness in the research design (Grunow, 1995). A similar relationship exists between data collection and analysis. S. Brown (2009) explained the relationship among a technique, method, and methodology. A technique is explained as a data-gathering procedure, whereas the method is the analytical procedures and process, and the methodology is the philosophical and conceptual framework that rationalizes the method and technique in relation to the phenomenon under investigation. Different studies have used methodologies that have explained causal relationship by experimental or quasi-experimental design methods or through qualitative analysis using descriptive explanations of lived experiences (Singleton & Straits, 2010).

Whether the investigator in a research project was using a quantitative or a qualitative approach in respective areas of studies, further investigation into the matter to seek additional answers for filling the gaps in the knowledge base is recommended frequently. Traditionally, the same object of scientific investigation is subjected to nomothetic (universal laws) or idiographic (distinctiveness related with individuals) investigation, a general law is resultant from many individual observations (Gelo et al., 2008). A combination of quantitative and qualitative understanding of the research question would provide holistic knowledge. McLean et al. (2005) explained that Q-methodology has the ability to merge quantitative and qualitative methodologies for a subjective understanding of the data.

Baker et al. (2006) explained Q-methodology as an alternative or complementary mode of inquiry. It includes the in-depth subjectivity of the qualitative approach with mathematical quantitative breakdown using techniques of factor analysis. Baker et al.

explained Q-methodology could fill in the understanding about the underlying assumptions and provide added meaning to the data.

Some empirical studies were questioned for their underlying assumptions with inconsistencies and irrationalities in their theories. Consequently, this led to the development of new types of methodologies that incorporate both the subjective nature of the assumptions and analysis of data using quantitative techniques and assumptions (Baker et al., 2006). Q-methodology shares the characteristics of a qualitative study because of its virtue of self-reference, that is, it does not impose a priori (working off of something that was already known) construct on its subjects (respondents). It allows for subjective opinions, beliefs, and values to be part of the analysis. Because of the self-referent nature of the research method, it does not seek a design with a large sample size (Baker et al., 2006). The opinions, values, and beliefs of the small sample study could be analyzed quantitatively with correlation and factor analysis techniques to find common patterns among subjective viewpoints.

Q-methodology accounts for study respondents' viewpoints. Each respondent's viewpoint is important and valuable for research. The specificity of population and sample is not very definite in Q-methodology, whereas in quantitative research, the specificity of the sample plays a big role in data analysis and for generalizability of the statistical results for the population (Amin, 2000). The generalizability is limited in the Q-methodology research. This methodology is exploratory in nature as it uncovers opinions, in-depth subjective analysis, and further categorization of opinions for future study. The universal generalization into a law is not pursued due to the size of the sample of respondents used in the study. Furthermore, Q-methodology does not use a randomly drawn sample from a population as the sample of participants is typically chosen from a group that has significant relevance for the topic and a strong interest in the topic (Amin, 2000). The author further discussed the reliability of Q-methodology, saying that Q-methodology uses test and retest methods for reliability. A coefficient correlation of over .80 is considered to be high.

McKeown and Thomas (1988) explained how Q-methodology is distinctive from other methods. Q-methodology uses a framework that facilitates idea generation in an unrestricted environment. It does not always involve a defined theoretical framework in the beginning. The individual's point of view is the foundation of Q-methodology. It posits on the paradigm that an individual's subjectivity is communicable to others and subjectivity advances from a point of self-reference. McKeown and Thomas further explained that Q is based on the underlying principles of analyzing human behavior. The purpose for considering Q has been to employ small numbers of respondents for an in-depth study integrating the tenet of self-reference in human subjectivity. The subjectivity of an experience is associated with personal opinion, and because opinions are not provable, Q-technique provides a form and structure for such observations (McKeown & Thomas, 1988).

The Overview of Q-Study

Q-methodology has been characterized as a quali-quantilogical analytical approach. Dziopa and Ahern (2011) described some of the distinctive characteristics of Q-methodology. The authors began by stating that Q uses stimuli known as the Q-sample, or a set of statements about different opinions on issues under consideration. The participants rank the sample of statements or any other stimuli according to their own point of view or belief. The subjectivity in rankings has been the core element to the Q-methodology. Dziopa and Ahern explained the differences between traditional R-method and Q-method. The distinction between the two is that the person or respondent does not receive scores, but in Q analysis the statement, test, pictures, or traits receive scores unlike the traditional R-method statistics. Thus, Q analysis uses by-person factor analysis. Q-technique uses *n* for the number of tests or statements rather than *n* for the people composing the sample size or number of respondents who participated in the study. The explained difference is that the *m* number of people took the *n* number of tests or statements (Dziopa & Ahern, 2011).

Webler et al. (2009) stated that the first step of a Q-study is the identification of a concourse. A concourse is an assembly of opinions associated with the issue under observation, also known as Q-statements. The opinions could be in the form of ready-made statements extracted from available literature or through interviews of the individuals who are associated with the phenomenon as experts or actors. Thus, Q-statements define various perspectives on the topic or issue. A Q-sample constitutes a strategic selection of statements from the larger set of Q-statements. A Q-sample represents the diversity of perspectives on the issue. Dziopa and Ahern (2011) explained that a Q-sample could be of two types: structured or unstructured. When items of statements are organized based on an a priori arrangement of constructs fitting into a conceptual framework, a Q-sample is stated as a structured sample. When items are selected randomly, it represents an unstructured concourse.

The goal of structured sampling is to find a representative sample of a larger process that is being modeled. Unlike structured sampling, unstructured sampling does not concern itself with the underlying modeled construct (Dziopa & Ahern, 2011). Next, the respondents are given instructions defining the experimental conditions under which they could provide their viewpoints or perspectives (Dziopa & Ahern, 2011). This study used an unstructured Q-sample as the statements were randomly selected from the peer-reviewed literature subscribing to prior discussion on the recognized barriers in EHR technology adoption.

Webler et al. (2009) stated that Q-participants express their views by sorting the statements according to their perceived agreeability or disagreeability. Thus, each participant provides a rank order for the statements called a Q-sort using structured instructions. Dziopa and Ahern (2011) explained the process of Q-sorting has the participants compare and rank the Q-sample items using a quasi-normal distribution grid. The process of Q-sort includes a small number of items being put at the extreme end of the distribution with the majority being placed in the middle by the respondents of any Q-study. The participants either strongly agree or disagree with the items at the extreme ends of the distribution. Items ranked are not functionally different; rather they suggest the degree of agreement or disagreement with the participant's own beliefs.

Once the ranking was completed, the analysis associated with the Q-technique does not enumerate how many participants in the study associated with the variable, rather it analyzes the number of beliefs to which a participant subscribed. For example, a number of physicians might believe that small incentives would encourage the adoption of the system into their work environment, while some might believe that large incentives would encourage the adoption of the system or some might believe that no amount of incentives would make them adopt the system. A by-person factor analysis accounts for the similarities and dissimilarities among participants (Dziopa & Ahern, 2011). Participants are grouped based on similarity in their sorts. Common viewpoints present as correlations between personal profiles of the respondents. The existing clusters of correlations are factorized representing common viewpoints (van Exel & de Graaf, 2005). Webler et al. (2009) explained Q-sorts have been statistically analyzed using techniques of correlation and factor analysis for determination of the underlying patterns of themes in the data. A similar interpretation of results revealed social perspectives on EHR barriers related with adoption and diffusion for this study.

The techniques of correlation and factor analysis provided the platform for quantitative analysis of subjective perspectives concerning EHR diffusion issue. McKeown and Thomas (1988) explained that the Q-technique added rigor to the studies dealing with human subjectivity especially in conditions with limited grants and funding. Their data analysis determined the intercorrelation among Q-sorts. It is the people rather than the traits or items of the Q-sample that determined the correlations. The magnitude of association of each respondent's point of view to another is indicated by the loadings on that factor. Finally, factor scores are calculated for each statement of the Q-sample. Factor scoring helps in interpreting the meaning of the statements in two different ways: the combined scoring of each factor and statistical ranking of statements in the array.

As discussed in the previous paragraph, the Q-technique uses respondents who are performing the Q-sort as variables in statistical analysis, not statements of the Q-sample. The technique is based on the tenet that respondents with similar perspectives will show significant association to a given factor. McKeown and Thomas (1988) further explained that the Q-technique uses sequential statistical procedures of correlation, factor analysis, and computation of factor scores. The author described the first step in Q-technique is the determination of correlation.

A correlation matrix demonstrates the linear relationship between variables (respondents in Q) in the Q-study. The correlation matrix is the basis for further factor analysis, which is second in the sequence of data analysis for the Q-method. These respondents were grouped based on the results of factor analysis. Furthermore, each respondent's factor loading is indicative of the degree of association between the individual's Q-sort and underlying composite attitude or perspective on the factor. A negative loading indicates the rejection of the factor's perspective. Examination of factor scores for selected items reflects the underlying themes distinguishing the respondent's perspective on the issue.

Issues of Reliability and Validity in Q-Methodology

Q-methodology has been used to analyze an individual's perspective. Because personal views are not opposable, the assessment of any individual's perspective does not need external validity. Content validity of the statements included in the Q-sample could be achieved by having them examined by an expert connected with the issue. A pilot study is recommended to ascertain the validity of the Q-statements and procedures of Q-sort.

Traditionally, Q-methodology has been characterized by small sample size; therefore, these studies are less influenced by a low-response rate. The reliability is not a concern for the researcher because of the small sample size used in the Q-study (Valenta & Wigger, 1997). The measure of reliability used in a Q-study is to test whether the same individuals would produce the same results over time (Dziopa &Ahern, 2011). A different Q-set could be used with a separate set of respondents to determine if the conclusion converged from both Q-samples.

Data-Collection and Q-Study Processes

The first step in the data-collection process is to develop the concourse of statements or items. A concourse is a collection of all relevant discourse available related with the issue under investigation. The selection of Q-sample statements takes place from the collection of statements in the Q-concourse. Different sources provide the concourse of statements. The sources include opinion statements of experts in the domain of technology and the medical field. The experts such as project managers, IT administrators, and physicians actively involved with EHR systems would exemplify as reliable sources for the Q-concourse statements for this investigation. Other sources of the statements were from the literature review.

The Concourse and Q-Set

In a Q study, concourse is the important communicable material that flows around a subject or topic. It contains all the relevant discourse available on the topic. The development of a concourse is supplemented in a number of ways through interviews, scientific literature, popular literature, observation of people, and books by experts (van Exel & de Graaf, 2005). Adding interview comments from the participants who were being studied in the concourse was one of the advantages of doing a Q-study. It reduced the researcher’s bias of creating the stimuli (Webler et al., 2009).

van Exel and de Graaf (2005) discussed the process of the development of the concourse. A concourse contains a larger set of statements on the topic, whereas a subset of the pertinent statements exemplifying diversity of opinions determines the Q-set.

Selecting the actual statements from the concourse to form the Q-set or Q-sample is more of an art rather than a science (van Exel & de Graaf, 2005). The characteristic of a good Q-statement is that it should be a short and easy to understand standalone statement. A Q-statement may be interpreted differently by different participants (Webler et al., 2009).

There are different ways Q-statements could be developed. McLean et al. (2005) explained that Q-statements can be determined in two ways: naturalistic or readymade. Naturalistic statements are gathered through the process of interviews, while ready-made statements are gathered from sources other than interviews, such as books, scholarly journals, and popular media. Webler et al. (2009) proposed that the interviews should include individuals with an in-depth knowledge on the issue and represent a cross section of stakeholders.

The Q-statements for this investigation used a hybrid of naturalistic and ready-made statements. The interview with a physician who had adopted the EHR system in the last 5 years and a project manager who was instrumental in implementation of an EHR system provided the naturalistic statements for the Q-set. The ready-made statements were selected from scientific journal articles used in the literature review presented in Chapter 2. A sample of Q-set statements is listed in Appendix A.

The barriers for EHR adoption that dominated the Q-concourse fell into broad categories of financial, technical, time, organizational, and change (Boonstra & Broekhuis, 2010; Castillo et al., 2010). Each factor was dominated by two levels of characteristics. The financial factor was dominated by startup and ongoing system maintenance costs. Startup migration and daily record maintenance affected the time factor of EHR usage. Daily record maintenance encompassed time efficiencies resultant of effective software usage of the interface and flow of tasks. Time efficiencies were also influenced by personal traits of cognition and motivation.

Initial system selection and ongoing technical proficiency were the two sublevels of the third factor called technology. Having an organizational culture of innovation and management's leadership, as a whole, significantly dominated the organizational factors. Last, change in processes and work practices and changes with autonomy redistribution emerged as the subcategories for the change factor. The analysis used factors and factor levels for a single dimension of imminence of an adoption by a decision maker.

Table 1 lists the factors levels related to barriers, thus each factor category was dominated by two sublevels of related characteristics. The arbitrary categories in the concourse will be replaced by the operant categories with the meaning given by the respondent through their subjective perspective (McKeown & Thomas, 1988).

Table 1

Concourse Factors and Factor Levels

No.	Factors [A]	Level	Items
a	Financial	Startup	2
b		Ongoing costs/revenues	
c	Time	Migration of records	2
d		Patient record maintenance tasks	
e	Technology	Software selection	2
f		Ongoing technical proficiency	
g	Organizational	People and culture	2
h		Management	
i	Change	Work practices	2
j		Autonomy redistribution	

Note. [A] signifies the factor.

The Q-Sample

The selected Q-sample included the range of diverse perspectives. The Q-sample was a set of stimuli given to the respondents for the purpose of assigning a rank sorting based on their personal reference of values and experiences. The physicians completed the rank sort of the Q-sample statements as given in Appendix B. Dziopa and Ahern (2011) explained that Q-sample statements are not a measure of a construct and do not show the impact among different variables.

Q-sample is the miniature representation of the concourse of perspectives. No matter whether the Q-sample used a random or theory-based structure, the meaning to the statements is given by the respondents. van Exel and de Graaf (2005) explained that other comparative studies in the past have shown Q-sets that used different structures converged for the same conclusions.

The selected Q-statements for this investigation incorporated divergent viewpoints on the five types of barriers listed in the Q-concourse section. Each of the five adoption barrier with two sublevels was reproduced along a single dimension of imminence of adoption and usage termed as *imminent adoption* [B] or k (see Equation 1, Table 2). This resulted in 10 combinations as listed in Table 2 (McKeown & Thomas, 1988). Furthermore, the Q-sample design included appropriate representation of beliefs and clearness about the topic by having each barrier sublevel replicated with five related statements. Thus, the factor and factor levels were multiplied by the dimensions [B] and the number of replications for each level [m]. Equation 1 for the computations follows:

Q-Sample (N) = (Factors and Factor levels * Dimension) * (Replication)   (1)

= ([A] * [B]) * (m), whereas,

Factor and factor levels [A] = 10; Dimension [B] = 1; Replication (m) = 5

Q-Sample (N) = (10 * 1) * 5

In sum, the Q-sample for this study had 10 types of statements for each barrier factor inclusive of its two levels. The resulting research matrix consisted of 10 different combinations, 2 x 5 = 10. To integrate the variety of expressions, each level was replicated five times. This replication resulted in 50 statements within the Q-sample. The unstructured sampling did not concern itself with the any underlying modeled construct (Dziopa & Ahern, 2011). The research matrix is given in Table 2.

Table 2

Research Matrix

		Financial		Time		Technology		Organizational		Change	
		a	b	c	d	e	f	g	h	i	j
Imminent adopter [B]	k	ak	bk	ck	dk	ek	fk	gk	hk	ik	jk

The Participant Set

Q-methodology is superior because it emphasizes research about qualitative traits, including how and why people think the way they do, but it does not count how many people think in a certain way. A Q-methodology study is characterized to not require a large sample size (Valenta & Wigger, 1997). The purpose of an adequate sample size is to establish the existence of a factor by the subjects or participants for comparison among two or more individuals. The participant set considered for the investigation in this study was not random. The P-set was purposive and included people who were involved by the issue (van Exel & de Graaf, 2005).

Sample size and P-set or participant set is seen differently in a Q-study. McLean et al. (2005) discussed that sample size is determined in a Q-study differently than in a survey or quantitative study. They stated that the sample size in a Q-study is the number of people who sorted the Q-sample multiplied by the items on the Q-sample. For example, if 15 participants sorted the Q-sample of 40 items, then the sample size is 15 times 40, equaling 600.

Two rules determined the number of participants needed in a Q-study. In this methodology, empirical observations are the statements used in the Q-sample. Q-sorts are the variables of the study. Previous studies using this methodology aimed for 1:3 ratios between the number of sorts and statements (Webler et al., 2009). Webler et al. (2009) recommended one participant for every three statements in the Q-sample. It has not been unusual to have a ratio of 1:2 in certain studies. The current study used a Q-sample of 50 statements. A minimum of 17 sorts was ensured for the purpose of reliability. The study used respondents who were practicing physicians working in small-sized facilities with up to five physicians. All participants in the study used or will use an EHR system in the next 24 months.

The Q-Sort and Related Procedures

Respondents of this investigation based on their point of view rank ordered the Q-sample. The stimuli of Q-sample were provided with a condition of instructions. A condition of instructions is a guide for sorting Q-sample items. Instructions to the respondents included a request for them to sort the items according to those with which they most agreed (+5) and to those with which they most disagreed (-5). The respondents sorted the items into three piles: those with which they agreed, those with which they disagreed, and in the middle, those with which they held a neutral opinion. A recording of the statement scores (-5 t o+5) for the respondent's completed sort along with the statement number produced a Q-sort distribution (see Figure 1). The participants had the freedom to sort the cards by moving them around the grid at any time of their sort. The prioritization of respondents' agreements and disagreements was either voluntary or forced. Deviations from normal distribution did not affect the results of the study. The respondent used the full width of the distribution (Webler et al., 2009). The study used a web based Q-sorting instrument for the physicians as the geographical area under consideration was quite large.

Pilot Study

A pilot study provided the steps to identify any issues with data collection that might affect the actual data collection. The pilot study provided the opportunity to document any errors in the selection of Q-sample statements and minimize any procedural deficiencies in the Q-sort process. This activity was to test if the Q-statements were meaningful and clear. The pilot study measured the validity of the research instrument and other procedural issues with the research design.

Data-Analysis Procedures

The process of Q-sorting by participating physicians concluded the data-collection phase. The Q-sorts expressed in a quasi-normal distribution were analyzed further. The quasi-normal distribution listed a small number of items placed at the extremes with most items being placed in the middle. Depending on the size of the Q-sample, typically 11 to 13 categories of perspectives were expected to show up in the quasi-normal distribution (Dziopa & Ahern, 2011). The data analysis used three sequential applications of statistical procedures. The procedures included a correlation matrix showing the correlation, a factor analysis, and the computation of factor scores (McKeown & Thomas, 1988). A correlational matrix using PQMethod 2.20 (Schmolck, 2011) software indicated the level of (dis)similarity between individual sorts. The dis(similarity) was the degree of difference in point view among the physicians regarding the importance of each factor as a barrier in adoption of the EHR technology (van Exel & de Graaf, 2005).

The results of the correlation matrix were the source for factor analysis. Factor analysis provided the groupings of Q-sorts or groupings by person. The factor extraction was the next step. The final number of factors depended on the variability in the elicited sorts (van Exel & de Graaf, 2005). Centroid or principal component analysis (PCA) have been the two commonly used methods to extract the components with judgmental or varimax rotation for the maximization of statistical differences. The advantage cited in past research studies for centroid extraction was that it provided an indeterminate number of factor rotations (Dziopa & Ahern, 2011).

Similarly, the PCA method extracted factors, but factors with eigenvalues of more than one were considered. Physicians with similar views shared the same factor or factors. A factor loading provides the extent of how each sort was associated with each factor (van Exel & de Graaf, 2005). In this case, factor loading determined the correlation between each sorted factor. Participants' Q-sorts that did not load significantly for any factor were removed (Dziopa & Ahern, 2011).

The computation of factor arrays determined the best fit Q-sort for participants loading significantly on a factor. A factor array composed the factor score for each item in the array. A factor score resulted as the Q-item score or Z-Score and the normalized weighted average value (Dziopa & Ahern, 2011). The results of the data analysis are described in Chapter 4 of this study.

Ethical Considerations

The investigation for this research was within general standards of scientific inquiry, including the parameters set by Walden University's Institutional Review Board as indicated with IRB approval number 08-12-11-0118863. The focus of ethical considerations in the study was to maintain logical reasoning, objectivity as well as control of bias and error. The ethical practices of social scientists require that research be conducted with care for human subjects and with truthful practices in gathering data and presenting the results (Singleton & Straits, 2010). The rights of the participants were considered through principles of voluntary participation, confidentiality, informed consent, and anonymity (Trochim & Donnelly, 2007). The voluntary participation made it possible for participants to have the right to refuse to participate in the research at any time. The informed consent included an explanation of the study, its purpose, and procedures with a description of any risks involved for the participant in the event of participation in the study. The informed consent form provided instructions on how to contact the researcher for further questioning on the procedures concerning the process of data collection and handling. The respondent was assured of anonymity by explaining the procedures guaranteeing privacy of the participant's personal information. The collection of data took place through a web application, and it de-linked the data and identity of the participant.

The criteria used for participation were any physician working in the Midwestern part of United States who is also employed or owner in a facility with up to five physicians and who is in the process of adopting an EHR or has adopted an EHR in the last 5 years. The study did not involve working with children, residents living in a facility, or any other protected population. The communication sent to the physicians for the purpose of data collection for this investigation provided full disclosure of the purpose of the study and voluntary nature of participation. The approached respondents had enough opportunity to ask questions about the study and its procedures.

Scientific norms demand intellectual integrity for the sole reason that the discipline of research, and inquiry rests on the soundness and trustworthiness of data from researchers in the field for its current use in the development of applications and future progress in knowledge development (Singleton & Straits, 2010). The respondents were assured of confidentiality of information obtained from them. The security of password protection for electronic data applied to all information gathered for this study. The data collection and data analysis were conducted in a format that minimized bias and error.

Q-study method research is not concerned with validity and reliability of data. There was no external criterion to evaluate a person's perspective, thus elaborate validity tests were unnecessary. Similarly, the perspectives of individuals could not be tested for reliability.

Social Change Implications

Q-methodology enabled systematic analysis of qualitative data. The qualitatively analyzed data for this study included viewpoints of physicians on factors of EHR technology adoption or rejection in small practices. Its results provided the backdrop to elicit individual preferences for understanding the efficacy of human motivation, organizational, and economic drivers in EHR implementation in private practices. A comparison of responses of respondents provided insight into suitable adoption interventions based on how physicians in small practices perceived adoption, implementation, and usage constraints. Interventions that would minimize the barriers used self-referred preferences as guidelines for an effective usage of the technology. The social implication of the study's results and conclusions helped physician practices develop an adoption plan that was focused on software selection, work-practice changes, and formulation of achievable outcomes in the areas of financial benefits and health quality. Furthermore, the conclusions regarding typology of adoption factors could be used in future research to understand other domain-specific technologies that may be used in other industries for quality and improved service outcomes.

Summary

The objective of Chapter 3 was to select the best framework for research methodology for this study. The systematic review led to an understanding that a research design needed to support the epistemological philosophy. Epistemology needed to be in alignment with the selected methodological approach. The selection of Q-methodology with the primary emphasis on a mixed -method approach was justified for its ability to statistically build on the subjective viewpoints of individuals using the dimension of imminent adoption.

The focus of Chapter 3 was to set the criteria and process to develop the Q-statement set, Q-sample set, P-set, and Q-sort. PQMethod 2.20 software developed by Schmolck (2011) was used to complete factor extraction on the basis of factor loadings. The degree of association between individual's sort and the underlying combination of perspectives helped elicit the extracted factors. The factor scores of the distinguishing items produced the underlying themes distinguishing the respondent's perspective on the issue. Chapters 4 and 5 describe the data analysis and interpretation of results. The significance of the results became the foundation for the description and explanation of the suggested interventions. The study concludes with recommendations on future research, actions, and conclusions drawn from the study.

Chapter 4: Data Analysis

The National Ambulatory Medical Care Survey conducted by the National Center for Health Statistics (Hing & Hsiao, 2010) collected information on EHR use for year 2007 and estimated that 34.8% physicians were using all or a partial EHR system in their office-based practice. A similar survey presented the data on EHR usage for the year 2011. Hsiao et al. (2011) stated that the National Ambulatory Medical Care survey showed an increasing trend of EHR use by office-based physicians in 2011. The survey showed 57% of office based physicians were using a computerized EHR system. The authors further stated that incentives provided with meaningful use of EHR adoption were likely to be sought by 52% of physicians in 2011 (Hsiao et al., 2011). The physicians applying for meaningful use incentives ranged differently in different states. For example, 70% of physicians were applying for such incentives in the state of Wisconsin versus only 26% in the state of Texas (Hsiao et al., 2011).

Even though the National Ambulatory Medical Care Survey (Hsiao et al., 2011) suggested 57% of office-based physicians were using a computerized EHR system, prior literature (Agarwal et al., 2010; Simon et al., 2006) stated that physicians and hospitals have been adopting EHR at a relatively slow rate when compared to other developed nations. A number of barriers have been attributed for the slow adoption rates in the U.S. These barriers have been categorized as financial, time, technology, organizational, and change (Boonstra & Broekhuis, 2010; Castillo et al., 2010). Furthermore, Carayon et al., (2009) stated that small practices are characterized by limited financial and human resources. The healthcare professionals of smaller clinics have to share job responsibilities thus barriers like finance, time, technology, organization, and change are critical. This study investigated the subjectivity associated with these critical barriers by physicians in smaller practices.

A study using Q-methodology was employed to address the following questions:

1. What subjective perceptions may help overcome the adoption barriers of EHR technology in small medical practices of up to five physicians?

2. What subjective perceptions may help overcome the postadoption barriers of EHR technology in small medical practices of up to five physicians?

3. How might physicians use the ranking of observed subjectivity to get empowered for a successful adoption and implementation of EHR?

The preadoption and postadoption issues with EHR system are multilayered because of the complexity of technology in medical field. Q-methodology, a mix of qualitative and quantitative techniques, afforded the statistical analysis of the gestalt responses related to the complexities with the issue (Lazard et al., 2011). The inversion technique of factor analysis allowed detection of the association between patterns expressed on the issue by physicians working in small practices (Lazard et al., 2011).

The research investigation used the Q-technique for data gathering and Q-method for data analysis to evaluate the issues. The data analysis in this research included three different scenarios. The first scenario included all participants, EHR users (partial or full) and nonusers (paper charts with electronic billing or paper charts with no electronic billing), as a comprehensive group to determine the underlying factors of EHR system acceptance and diffusion. Next the two scenarios of data analysis included whether the participants were already using EHR or were thinking of using one in next the 24 months.

The analysis of these two separate subgroups determined how perspectives differentiated among them for factors of acceptance and adoption, respectively.

The criteria defining users of an EHR system arrived from the 2010 report by the National Center for Health Statistics (Hing & Hsiao, 2010). Hing and Hsiao (2010) suggested the criteria for a basic user of an EHR system was a user who completed the following functions with an EHR system: keeping patient demographics, patient problem list, physician's clinical notes, highlighting of out-of-range lab and imaging results, and computerized orders of prescriptions. The basic functions described above were only a part of the comprehensive functions. The EHR's comprehensive functions included all the basic functions plus functions such as guideline-based interventions or screening-test reminders, drug interaction or contraindication warning provided, and public health reporting (Hing & Hsiao, 2010). The nonusers were those who used paper charts and paper submission or electronic submission of the billed charges. The study broadly analyzed the data for users and nonusers of the EHR system without going into details for the type of functional use.

Pilot Study

The actual data collection followed the pilot study. The pilot Q-method study helped in refining the data-collection process. Two individuals completed the pilot, a physician who was instrumental in the system purchase and implementation for a group of physicians and a project manager who managed EHR system implementation. The participants of the pilot study did not provide data in the actual study. After conclusion of the pilot, a revision of the Q-concourse included the addition of six statements based on the suggestions of these experts (see Appendix A, Items 91- 94 and 96). The suggestions to make the process more convenient and readable for a medical practitioner for an online Q-sort resulted in making the Q-statements more contextually appropriate for a medical user. A few of the Q-statements were simplified for readability purposes; every effort was made to maintain the original framework with respect to the appropriateness of the context. Furthermore, the pilot study provided the platform to test the time requirement, completeness, and process applicability to collect data from a participant. The actual participants for the study were approached through e-mail, phone, or both. Every participant received information regarding the purpose of the study and data-collection process with the web access medium using the researcher's web page at the time of personal contact.

Summary of the Data-Collection Process

The data collection followed after the participants gave their consent to participate in the study. The process of data collection started by dispensing a stimulus of 50 statements relevant to the characteristics of EHR systems and their users to physicians working in small practices with no on-board technical support. The Q-sample (stimulus), a miniature of the concourse of 96 statements resulted from journal articles, professional publications, and recommendations from experts on the EHR system adoption and diffusion. Thus, the 50 Q-statements representing diversity of opinions on the issue were selected, and they came from sources other than participant interviews (M. Brown, 2004; McLean et al., 2005). The research design for this study used five categories of factors with two sublevels in each category to understand the subjectivity associated with the issue.

A Q-sort technique of rank ordering the Q-sample provided the data. The researcher provided each subject or participant a set of instructions defining the conditions under which to complete the Q-sort (M. Brown, 2004; S. Brown, 1980). The participants were instructed to sort and rank order their opinions under three categories. The predefined categories were (a) most agreeable, (b) most disagreeable, and (c) neutral for the adoption and usage of EHR in their medical practice. A web-based Flash 10 application administered the process of sorting and rank ordering for each participant. The participants used a scoring continuum of -5 to +5 to reflect the most uncharacteristic (disagreeable) or most characteristic (agreeable) stimuli that influenced their behavior for the adoption and acceptance of the EHR system. The continuum of ranks (-5 to +5) using a Q-grid forced them to provide their answers in a quasi-normal distribution (M. Brown, 2004).

A Q-grid, as shown Figure 1, allowed participants to place the statements that were most pertinent to their viewpoint on the EHR adoption at the furthermost ends of the grid. The Q-grid had fewer rows at the outside ends, representing the most agreed or least agreed views, whereas the larger middle of the grid represented the neutral statements. S. Brown (1980) explained that the dynamics of Q-sorting resided in how participants provided the psychological significance to each statement. The statements on the extreme of the distribution had more salience, both phenomenologically and statistically under a specific condition of instructions. Phenomenologically, it was quite important to consider both negative and positive characteristics of a phenomenon.

	Least Agreed				Neutral			Most Agreed		
-5 (3)	-4 (3)	-3 (5)	-2 (5)	-1 (6)	0 (6)	1 (6)	2 (5)	3 (5)	4 (3)	5 (3)

Figure 1. Fixed distribution of the Q-sample for this study.

The investigation purposefully selected participants who were practicing in small (five or less physician partners or physician employees) independent practices. These physicians were not employed in large groups or hospitals, thus they did not have the support of a large information technology infrastructure and administration. Furthermore, the participating physician may have or had an affiliation with one or more local hospitals as an independent health provider, not an employee of such facility. Although a purposive Q-sample of 17 to 25 such physicians was proposed, data were collected from 41 physicians until the beginning of 2012. Thirty-five out of 41 sorts were analyzed because of the completeness of the demographic information.

Different Q-studies have used different criteria for determination of the number of Q-sorts for analysis purpose. According to J. Brown (2010), the size of P-set (participants) was not of critical consequence. The qualitative aspect of Q-methodology uncovers the patterns of thought; its goal was not to uncover how many people thought in a certain way but to uncover views that were shared by other people (J. Brown, 2010; M. Brown, 2004; Valenta & Wigger, 1997). Some Q-methodology studies have been done using a P-sample or P-set (participants) that was greater than the Q-statements; many other Q-studies aimed at a ratio of 1:2 or 1:3 between the number of Q-sorts and Q-statements (Webler et al., 2009). The goal of having an appropriate-sized P-set was to have representativeness not from the sense of proportionality but from the sense of diversity and breadth of participants in the P-set. J. Brown (2010) stated that the goal was to have a theoretical saturation through inclusion of participants holding diverse and broad perspectives. The participating physicians operating in Midwestern U.S. belonged to different medical specialties represented the diversity and inclusivity needed for theoretical saturation. The specialty and region of practice are listed in Tables 3 and 4, respectively.

Demographic Information for the Participants

The sample of this research included 35 independently practicing physicians providing medical services in Midwestern states of the United States. Physicians working in independent practices with five or less than five practitioners, irrespective of their status of ownership, and those who were either thinking of adopting the EHR system in next 24 months or who had adopted the EHR in the past 5 years formed the sampling frame for this investigation. Wisconsin medical practitioners were first contacted with a telephone or an e-mail communication. The response was moderate as a number of contacted physicians worked for large employers, thus could not participate in the study. Some of these physicians were helpful in providing the contact information of other independent medical practitioners in the Midwestern U.S. The physicians who showed willingness to participate in the study were contacted over weekends and in the evening to describe the purpose of the study. The willing physicians provided their consent and completed the data-collection steps with a web application. Tables 3 and 4 provide the demographic information of the sample used for this research. Table 5 provides the P-set of 35 physicians comprising four female physicians, 11.4% of the total, and 31 male physicians, 88.6% of the total. The age of participating physicians ranged from 39 to 72 years. The average age of the physicians in this research study was 55 years.

The demographic ratios applicable to this study compared closely to the Center for Studying Health System Change Health Tracking Physician survey sent to U.S. physicians via mail (Boukus, Cassil, & O'Malley, 2009). The physicians surveyed provided at least 20 hours per week of direct patient care.

Table 3

Participants by Specialty

Medical specialty	Number of participating physicians
Allergy and immunology	2
Dermatology	1
Family practice	5
Gastroenterology	2
General surgery	4
Internal medicine	5
Neurology	2
Neurosurgery	1
Oncology	1
Ophthalmology	5
Otolaryngology	1
Pain management	1
Plastic surgery	2
Pulmonology	2
Rheumatology	1
Total	35

Table 4

Participants by States in the Midwest

Midwestern state	Number of participating physicians
Illinois	4
Indiana	1
Michigan	11
Missouri	1
Ohio	1
Wisconsin	17
Total	35

Table 5

Participants by Usage of the Electronic Health Record System

Code	Gender	Specialty	State	City	EHR or EMR	Type
A-1111	F	Rheumatology	MI	Fort Gratiot	Y	Full
A-1112	F	Internal medicine	WI	Oshkosh	Y	Partial/Basic
A-1115	M	Pain management	WI	Oshkosh	Y	Partial/Basic
A-1117	M	Ophthalmology	WI	Oshkosh	Y	Full
A-1118	M	Neurology	MI	Saginaw	Y	Partial/Basic
A-1119	M	Pulmonology	MI	Franklin	Y	Full
A-1121	M	Dermatologist	WI	Oshkosh	Y	Partial/Basic
A-1122	M	Family practice	MO	Excelsior Springs	Y	Partial/Basic
A-1127	M	Otolaryngology	WI	Oshkosh	Y	Full
A-1129	M	Internal medicine	MI	Burtchville	Y	Partial/Basic
A-1135	M	Pulmonology	MI	Port Huron	Y	Full
A-1137	M	Ophthalmology	WI	Green Bay	Y	Full
A-1138	M	Neurology	WI	Oshkosh	Y	Partial/Basic
A-1139	M	Ophthalmology	IL	Chicago	Y	Partial/Basic
A-1142	F	Internal medicine	WI	Oshkosh	Y	Partial/Basic
A-1143	M	Ophthalmology	IL	Chicago	Y	Full
A-1144	M	General surgery	WI	Sheboygan	Y	Full
A-1147	M	Plastic surgery	WI	Oshkosh	Y	Full
A-1150	M	Ophthalmology	IL	Chicago	Y	Full
A-1151	M	Family practice	WI	Oshkosh	Y	Partial
A-1114	M	Internal medicine	IL	Naperville	N	None
A-1116	M	General surgery	MI	Flint	N	None
A-1120	M	Neurosurgery	WI	Oshkosh	N	None
A-1123	M	Internal medicine	WI	Milwaukee	N	Not using currently
A-1124	M	Gastroenterology	WI	Oshkosh	N	None
A-1126	M	General surgery	MI	Port Huron	N	None
A-1128	M	Family practice	MI	Gladwin	N	None
A-1130	M	Oncology	OH	Lima	N	None
A-1131	M	Plastic surgeon	MI	Flint	N	None
A-1132	F	Gastroenterology	WI	Oshkosh	N	None
A-1134	M	Family practice	MI	Port Huron	N	None
A-1140	M	Allergy/immunology	WI	Green Bay	N	None
A-1145	M	Family practice	IN	Terre Haute	N	None
A-1146	M	General surgery	MI	Port Huron	N	None
A-1148	M	Allergy/immunology	WI	Appleton	N	None

Note. EHR = electronic health record; EMR = electronic medical record; M = male; F = female; Y = yes; N = no.

Boukus et al. (2009) stated that one third or 33% of the physicians practiced in solo or two-physician medical offices and 15% were in three- to five-physician medical offices. In the United States, 75% of the total physicians were of male gender. Furthermore, the results of the survey conducted by the Center for Studying Health System Change suggested that 80% of the physicians worked full-time, and 53% of them were in the age group of 40 to 55. Thus, the demographic data of the present study were in close approximation of the national statistics.

In this study, 20 physicians claimed that they were either using partial, basic, or full EHR systems in their practices. In the P-set, 15 physicians were currently not using any EHR system other than just electronic billing. Out of 15 physicians, one had used EHR system before but had discontinued the use of an EHR system in the practice. Table 5 presents the figures of EHR use in the P-sample.

Factor Analyzing the Q-Sort for EHR Acceptance and Usage

Factor analysis helped explain the variability among the correlated variables through factors. Studies dealing with large number of variables face the challenge of reduced statistical power as some of the variables may be redundant (J. Brown, 2010). Principal component analysis provides a means to reduce redundancy in variables (J. Brown, 2010). Principal component analysis used in this study explored the correlation among sorts and determination of patterns among the variables of the current study (J. Brown, 2010).

The first step undertaken in the statistical analysis of the data was to determine the correlation among individual Q-sorts. Each respondent arranged or sorted the Q-statements according to his or her own viewpoint. Correlation is a measure of how similarly or dissimilarly two different individuals arranged the 50 Q-statements. A score that is closer to +1 represents a positive relationship among the Q-sorts, whereas a score closer to -1 represents a negative relationship among the Q-sorts.

The study analyzed the subjectivity that existed in perspectives regarding diffusion of the EHR systems by imminent adopters of the EHR system using five factors: (a) financial, categorized into startup and ongoing costs; (b) time, categorized into first-time migration of records and the ongoing record maintenance; (c) technology, categorized into initial selection and ongoing technical proficiencies; (d) organizational, categorized into culture of innovation and support and top management initiatives; and (e) change, categorized into work processes and autonomy. The study investigated why some physicians were more hesitant to adopt the technology. Furthermore, it investigated what contributed to faster acceptance and continued diffusion of the EHR technology once adopted by the physician. Therefore, factors unique to the sample of nonuser physicians were compared to user physicians and the comprehensive group.

Kline (1994) defined factor analysis as a statistical technique that aimed to simplify a complex set of data by condensing the matrix of correlation. The outcome of factor analysis in a Q-methodology study is to define factors supported by the correlation among the Q-sorts of the participating respondents (S. Brown, 1993). A three-step analysis was conducted for this study. The sequential steps were: (a) determination of correlation, (b) the factor analysis, and (c) the computation of factor scores (M. Brown, 2004; Budaev, 2010).

Budaev (2010) stated that principal component analysis uses the correlational matrix generated in the first step and transforms it to an orthogonal new set of principal components using a linear combination of original measures with each accounting in decreasing proportion of the total accounted variance. The third step, according to Budaev, is the loading of original measures on these principal components, representing the correlation between original measures and extracted principal components. The three-step data analysis was conducted with PQMethod 2.20 software developed by Schmolck (2011).

Correlation Matrix

Factor analysis starts with the generation of a correlation matrix. It is a matrix of correlation coefficients of the variables with each other. A correlation is a numerical value that provides a measure of the degree of agreement between two sets of scores (Kline, 1994). When two sets of scores are in full agreement, a correlation value of +1 is generated, whereas a value of zero indicates no relationship or a value of -1 indicates disagreement (Kline, 1994). A correlational matrix is comprised of a set of correlational coefficients between different variables. The analysis used Pearson product moment correlations or Pearson *r*. The scoring continuum for the Q-sort in this investigation was from -5 to +5 with 0 being the mean. The formula used for determination of the correlation coefficient statistic or Pearson product-moment correlation coefficient was $r = 1.00 - (\sum d^2/2Ns^2)$, where *N* was the total statements in the study's Q-sample, equaling to 50. The s^2 in the above-mentioned formula was the variance of the forced distribution equaling to 7.76; d^2 was the sum of the squared difference in scores for the items between two Q-sorts (S. Brown, 1980). The denominator was a constant represented by $2Ns^2 = 776$. It included the variance of the forced grid, s^2 of 7.76 and N of 50, same for all the participants. The *r* for this study was computed with the formula of $(1 – [(\sum d^2/776)])$.

Clark (2008) stated the *r* or coefficient correlation is a ratio of the sum of the participants' respective squared difference to the sum of each combined pair of individuals subtracted from 1. The coefficient correlation *r* can range between +1 and -1 expressing the degree of similarity between any two sorts. A high positive value of *r* between any two sorts suggests two sorts are more alike and vice a versa. The 35 x 35 matrix of correlations for all pairs of Q sorts is shown in Appendix C.

The total entries in the raw data used for creating a correlational matrix of 35 x 35 was the number of participants, (lowercase) $n = 35$ multiplied by total number of statements, (uppercase) $N = 50$, 35 x 50 = 1750. Out of 1,750 data points, 595 were the different correlation coefficients. The total number of computed coefficient of correlation values (all the *r*s) for this study were $1/2(n^2 – n) = 1/2 (35^2 – 35) = 1190/2 = 595$ in number. The diagonal of the matrix consisted of the correlation of 1.00 because each sort would have a perfect correlation with itself. Furthermore, the correlation between sort 1 and 2 is same as between sort 2 and 1; therefore, the upper and lower half of the diagonal are identical, leading to the formula ½(n x [(n-1)]) (S. Brown, 1980).

A determination of significance at the level of 0.01 or 99% and at the level of 0.05 or 95% eliminated the likelihood of having the correlation happen by chance (Kline, 1994). A calculation for standard error (*SE*) determined the correlation significance.

$SE = 1/\sqrt{N}$

$= 1/\sqrt{50} = 0.141$

$SE * (SD \text{ at } P < 0.05) = 0.141 * 1.96 = 0.277 = 0.28$ (2)

$SE * (SD \text{ at } p < 0.01) = 0.141.* 2.58 = 0.364$, rounded to 0.37 (3)

SE was equal to 1 divided by the square root of total number of statements in the Q-sort (Clark, 2008). Clark (2008) further stated that a significantly correlated number is between 2 and 2.5 times the *SE*. Therefore, as *SE* was $1/\sqrt{50} = 0.141$. A 95% confidence level where $p < (.05)$, the value resulting by multiplying standard deviation (1.96) by *SE*, equaled to $1.96 \times 0.141 = .277$ rounded to 0.28. A 99% confidence level where $p < (.01)$, the value resulting by multiplying standard deviation (2.58) by SE, equaled to $2.58 \times 0.141 = 0.364$ rounded to 0.37.

Factor analysis provided the structure to simplify the correlational matrix of 35 sorts in a comprehensible smaller number of factors. Kline (1994) provided a definition of a factor as "a dimension or construct which is a condensed statement of the relationships between a set of variables" (p. 5). The correlations of a variable with a factor are expressed by its loading on that factor. The factor loadings defined an operational factor or a construct (Kline, 1994).

Factor Loading

The study expressed the perspectives of 35 physicians by performing principal component analysis with a varimax rotation on the results. PCA determined the components that accounted for the correlation between variants. The complex correlational matrix was simplified to explain the underlying factors (Kline, 1994). The two sets of values, eigenvector and eigenvalues, were used to estimate the correlation matrix (Kline, 1994). The eigenvector is a column of weights; weights are applied to each of the variables in the matrix (Kline, 1994). In this study, there were 35 variables, thus 35 weights in the first vector. The eigenvalue is the sum of the squares of the factor loadings on each factor representing the proportion of variance explained by each factor. The total amount of variance is the eigenvalue for the factor.

The second step was the extraction of factors from the correlational matrix. This step included rotation of the factors to maximize the relationship among variables. The objective of factor analysis is to simplify the structure of factors so that variants load high on one factor. Pett, Lackey, and Sullivan (2003) explained the process of factor analysis as a procedure that identifies the interrelationships among a large set of observed variables, which results into data reduction into a smaller set of variables or factors with common characteristics. A factor is a linear combination or cluster of related observed variables representing specific and distinct dimensions of a construct or an issue. The goal of factor analysis is to reach a smaller or parsimonious set of factors that best describes the interrelationship among the variables in a clear, succinct, and understandable manner (Pett et al., 2003).

The issue of EHR adoption and diffusion in smaller medical practices is multifaceted and has been explained in the literature through a number of dimensions. The correlation matrix of 35 Q-sorts was analyzed using principal components analysis using PQMethod 2.20 software (Schmolck, 2011). Factor analysis allowed the results to be sorted into idealized sorts, a particular arrangement of statements, also called factors. Two or more respondents, physicians with similar views about the adoption and usage of EHR system, would emerge as a single factor; conversely, physicians with dissimilar views did not share the same factor (van Exel & de Graaf, 2005). Factor loading determined how each Q-sort was associated with each factor (van Exel & de Graaf, 2005).

The factor analysis used PCA to reduce the large number of measures into an important smaller set of summary scores (Budaev, 2010). According to J. Brown (2009) and Kline (1994), the PCA method asserted that factors accounted for the variance and explained the correlation among the variables. Budaev (2010) explained that variables loading on the same principal component showed a common behavior mechanism and shared a large proportion of common variance. The extraction of principal components was an iterative procedure involving refinement of the solution with an eigenvector. An eigenvector of a correlation matrix is a column of weights. A principal component was extracted by multiplying the square root of the principal component's associated eigenvalue with each of the weights of the eigenvector. The weights generated from this computation are called factor loading. Factor loading represents the correlation of each item with the given principal component (Pett et al., 2003).

Factor Analysis

There were no specific rules that pointed out how to determine the total number of extracted factors for interpretation of results, although a number of stopping rules have been suggested for final factor extraction (J. Brown, 2009). J. Brown (2009) suggested statistical tests to determine the optimal number of variables in conjunction with some nonstatistical strategies (p. 19). Webler et al. (2009) said, "There is no one objectively correct number of factors to use, and any number of factors will give you some insight into how people think about the issue" (p. 31). Webler et-al. suggested the use of fewer factors for simplicity as long as the important information regarding the embedded viewpoint is not sacrificed. J. Brown (2009) suggested the (a) Kaiser's test, (b) Scree plot test, (c) number of nontrivial factors, and (d) percentage of explained variance as different combination of tests that could support the determination of the number of factors for analysis.

The main objective of using these tests was to extract a smaller number of factors that would explain large amounts of the overall variance without exaggerating the specifics (J. Brown, 2009). Budaev (2010) recommended the widely used rule of extracting factors with eigenvalues of greater than 1 (p. 475). This has been described as the Kaiser's rule. The Kaiser's rule suggested that factors with an eigenvalue of greater than 1.00 should be considered in analysis. There were eight unrotated factors brought forward that had eigenvalues of greater than 1 (see Table 6). Because this did not provide a conclusive result on the number of factors to be extracted for subjective interpretation in the analysis, provision of other stopping rules transpired.

Next, a Cattell's Scree plot graphed visually the relationship between relative magnitudes of eigenvalues and the number of factors. The underlying principle of this rule is that the precipitous drop in the graph indicates the number of factors to be included in factor analysis (J. Brown, 2009; Budaev, 2010). As indicated by the scree plot for data collected in this study (see Figure 2), the line dropped precipitously after Factor 1. The second drop was after Factor 2; thus the scree plot suggested a two-factor solution.

The Kiaser's rule and Cattell's Scree plot did not provide converging results on the number of factors to analyze. The next stopping rule was the test of nontrivial loading. J. Brown (2009) explained trivial factors are the factors that do not have three or more variables loading above the cut-off point. The cut-off point was calculated using the estimated error for 0.01 level of significance or $p < 0.01$ was above 0.364 rounded to the next number of 0.37. Table 7 shows the factor loadings for each variant when the data were processed with PQMethod 2.20 software (Schmolck, 2011). Three of the factors loaded for more than three loadings. Therefore, a three-factor solution was used for the final analysis.

Table 6

Unrotated Factor Matrix With Eigenvalues for Comprehensive

		Factor							
No.	Sort ID	1	2	3	4	5	6	7	8
1	A1111U1	0.4881	0.1391	0.2830	0.2556	0.4433	0.2136	-0.0377	-0.2289
2	A1112U2	0.6902	-0.1397	-0.1809	0.2497	-0.0568	-0.2623	0.2439	-0.0838
3	A1115U4	0.2856	0.1892	0.5794	0.3132	-0.1577	-0.1435	-0.0237	-0.1935
4	A1117U5	0.5821	0.0776	0.2579	-0.0930	0.1719	-0.2302	-0.2622	0.2379
5	A1118U6	0.3072	-0.3519	0.4735	0.1985	0.3519	-0.2849	0.0680	0.0608
6	A1119U7	0.6356	0.0768	0.1744	0.1274	-0.1185	0.1768	-0.0944	-0.0651
7	A1121U8	0.4899	-0.3097	0.1692	0.1496	-0.0742	0.3266	0.3772	-0.0316
8	A1122U9	0.6880	-0.1600	-0.2728	-0.0984	0.0416	0.0013	-0.1649	0.0740
9	A1127U11	0.5936	0.2068	0.343	0.1757	-0.2711	-0.0498	-0.1693	0.0576
10	A1129U12	0.3893	-0.3193	0.3692	-0.2358	-0.1353	0.3909	-0.0257	-0.2604
11	A1135U14	0.4178	0.1695	-0.0259	0.5099	0.0843	0.1054	-0.0348	0.2009
12	A1137U16	0.4269	-0.0720	0.3567	-0.6645	0.0275	0.0025	0.1033	-0.1115
13	A1138U17	0.1310	-0.3159	0.1334	0.5954	0.2740	-0.1793	0.0673	-0.3195
14	A1139U18	0.5948	0.5399	0.0573	-0.0621	-0.0850	0.3020	-0.1223	0.0417
15	A1142U19	0.6000	0.4788	0.1610	-0.1673	-0.2939	-0.1060	-0.1008	-0.1734
16	A1143U20	0.3961	-0.2030	0.5312	-0.2829	-0.2744	-0.3249	-0.1245	0.0353
17	A1144U21	-0.3274	0.2174	0.1942	-0.2345	0.6296	0.0915	-0.0016	-0.1425
18	A1147U22	0.6892	0.0999	-0.0115	-0.0834	-0.1574	-0.1514	0.3631	-0.0898
19	A1114N1	0.2971	-0.3566	0.2046	0.0733	0.1403	-0.0302	-0.2370	0.5580
20	A1116N2	0.5286	-0.2445	0.0831	-0.0804	0.0740	0.6324	-0.0232	0.0899
21	A1120N3	0.5174	-0.0253	-0.1762	-0.2074	0.4759	-0.0780	0.1080	-0.1650
22	A1123N4	0.3032	0.5581	0.0846	0.0036	0.0742	-0.2444	0.4364	0.0730
23	A1124N5	0.6030	0.2407	-0.2719	-0.2292	0.3450	0.0155	-0.0598	-0.0392
24	A1126N6	0.5947	-0.3269	-0.1849	-0.0869	-0.0339	-0.2012	-0.3551	-0.1854
25	A1128N7	0.4006	-0.0566	-0.0093	0.0382	-0.1221	0.0623	0.4930	0.4066
26	A1130N8	0.7542	-0.1624	-0.1515	0.0522	0.0298	0.0674	0.0331	-0.2377
27	A1131N9	0.7533	0.0469	-0.0231	0.1342	0.1603	0.0399	-0.1371	0.1011
28	A1132N10	0.6285	0.1789	-0.2201	0.2607	-0.1106	0.1234	0.2013	-0.0287
29	A1134N12	0.3256	0.6929	0.1053	0.0327	0.1817	0.1384	-0.0815	0.2166
30	A1140N13	0.6895	-0.1896	-0.3529	-0.0038	-0.1519	-0.0297	0.0722	-0.0745
31	A1145N15	0.6538	-0.3687	-0.0089	0.0011	0.1637	-0.0600	-0.0144	0.2368
32	A1146N16	0.7019	-0.0469	-0.4128	-0.2870	0.1783	-0.1575	0.0448	0.0644
33	A1148N17	0.3941	0.2030	-0.3909	0.3085	-0.1283	-0.0578	-0.4457	-0.1227
34	A1150U23	0.6078	0.1995	-0.0056	-0.2094	0.0091	-0.2527	0.0816	-0.0095
35	A1151U24	0.7544	-0.2239	-0.1138	-0.0984	-0.2385	0.1144	-0.0556	0.0050
	Eigenvalues	10.409	2.7425	2.3605	2.0757	1.7831	1.5064	1.4459	1.2039
	% explained variance.	30	8	7	6	5	4	4	3

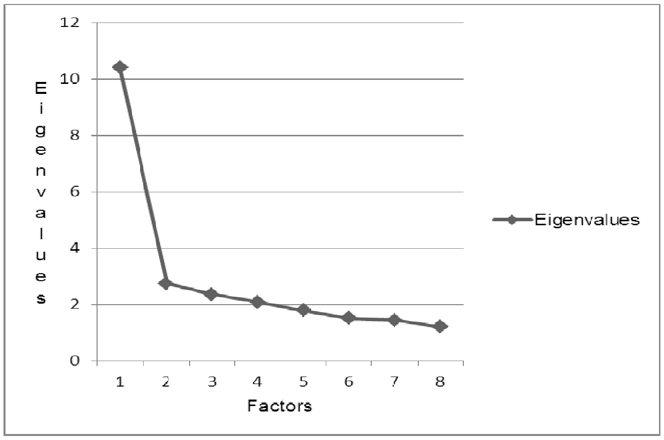

Figure 2. Scree plot for the comprehensive group of participants.

J. Brown (2009) explained the issue of triviality. The author attributed triviality as a matter of degree of loading on a variable. A loading of .71 or higher is *excellent*, a loading of .61 to .70 is *very good*, a loading of .51 to .60 is *good*, a loading of .41 to .50 is *fair*, and a loading of 0.30 to .40 is *poor*. J. Brown (2010) stated that higher loadings indicated purer measures of the underlying factors. Two or three loadings of .71 or higher are less trivial than four or five loadings of 0.40. Based on the absolute value of the loading, Factors 1 and 2 were less trivial than Factor 3 for the comprehensive group of all physician participants in this investigation (J. Brown, 2009).

The percentage of cumulative variance is one of the last tests used to decide on the number of factors for the analysis. A 35-variable (total number of respondents in the comprehensive group) solution would explain 100% variance, but it would not shed any light on the patterns of perspectives among the physicians. A higher percentage of cumulative variance explained by smaller number of factors suggested by other stopping rules helps account for the total percentage of cumulative variance. As observed (see Table 6), the addition of each factor explained more variance in the solution.

Table 7

Factor Matrix Defining Sort Loadings for the Comprehensive Group

No.	Q-sort ID	Loading 1	Loading 2	Loading 3
1	A1111U1	0.1652	0.4451XX	0.3351##
2	A1112U2	0.6674XX	0.1817	0.2242
3	A1115U4	-0.1793	0.4728XX	0.4443XX
4	A1117U5	0.267	0.4354XX	0.388XX
5	A1118U6	0.036	0.0148	0.6640XX
6	A1119U7	0.3581##	0.4365XX	0.3486##
7	A1121U8	0.3471##	0.0491	0.4915XX
8	A1122U9	0.7261XX	0.1363	0.1662
9	A1127U11	0.1923	0.5713XX	0.3866XX
10	A1129U12	0.1529	0.051	0.6032XX
11	A1135U14	0.2902##	0.3405##	0.0617
12	A1137U16	0.1272	0.266	0.4772XX
13	A1138U17	0.098	-0.1484	0.3211##
14	A1139U18	0.2819##	0.7544XX	-0.0021
15	A1142U19	0.2388	0.7390XX	0.1093
16	A1143U20	0.0315	0.1974	0.6635XX
17	A1144U21	-0.4195XX	0.0687	-0.107
18	A1147U22	0.5048XX	0.426##	0.2209
19	A1114N1	0.1913	-0.0757	0.4637XX
20	A1116N2	0.4121XX	0.0952	0.409XX
21	A1120N3	0.5049XX	0.1880	0.0956
22	A1123N4	0.0397	0.6298XX	-0.1113
23	A1124N5	0.5610XX	0.4171XX	-0.0822
24	A1126N6	0.6440XX	-0.0190	0.2821##
25	A1128N7	0.3236##	0.1542	0.1878
26	A1130N8	0.7039XX	0.2047	0.2843##
27	A1131N9	0.5736XX	0.4121XX	0.2669
28	A1132N10	0.5646XX	0.3958XX	-0.0004
29	A1134N12	0.0106	0.7562XX	-0.1589
30	A1140N13	0.7827XX	0.0889	0.1234
31	A1145N15	0.5934XX	0.0304	0.4586XX
32	A1146N16	0.7926XX	0.1923	0.008
33	A1148N17	0.4835XX	0.2450	-0.2357
34	A1150U23	0.4147XX	0.4670XX	0.1386
35	A1151U24	0.6967XX	0.1665	0.3451##
	% explained variance.	20	13	11

Note. Factor matrix with ## indicating a loading at a significance level of $p < .05$, or values > 0.28 and XX at a significance level of $p < .01$ or values of > .37 irrespective of the confounding nature of the factor.

The three-factor solution for the comprehensive group of physicians explained 44% of the cumulative variance, whereas the last five of the PCA factors explained only

24% of the variance. A one-factor solution as suggested by the Scree plot would have explained 30% of the variance out of the total of 68%, thus the application of stopping rules and related tests supported the decision to use three factors for analysis (J. Brown, 2009).

A greater than 0.5 correlation between the extracted factors shows a high level of relationship between factors. The correlation between the three factors is provided in Table 8. The correlation between Factor 1 and 2 was 0.4826, which was less than 0.5, indicating a less significant relationship between the two factors. Similarly, correlation values were less than 0.5 for other combination of factors. The correlation between Factors 2 and 3 was significantly less at 0.24 and that between Factors 1and 3 at 0.4256. This implied that participants who loaded on three factors did not share the same perspectives. The value of a perfect 1.0 in the diagonal statistic indicated within-factor correlations (see Table 8).

Table 8

Correlations Between Factor Scores for the Comprehensive Group

	Factor		
Factor	1	2	3
1	1.0000	0.4826	0.4256
2	0.4826	1.0000	0.2439
3	0.4256	0.2439	1.0000

Next, the test of reliability was undertaken for the comprehensive group of physician participants. The PQMethod 2.20 software (Schmolck, 2011) calculated the composite reliability. The composite reliability of 0.8000 or above for each factor was acceptable. The composite reliability when compared to the average reliability coefficient was found to be above 0.8000 (McKeown & Thomas, 1988). The calculation of composite reliability for each factor assumed that a respondent would rank order the statements in the same way at least 80% of the time. A strong reliability coefficient of 96% to 98% for three factors is illustrated in Table 9.

Table 9

Factor Characteristics for the Comprehensive Group

Factor characteristic	Factor 1	Factor 2	Factor 3
No. of defining variables	15	7	6
Average relative coefficient	0.800	0.800	0.800
Comprehensive reliability	0.984	0.966	0.960
SE of factor Z-scores	0.128	0.186	0.200

The PQMethod 2.20 software (Schmolck, 2011) calculated the values of standard errors for difference, indicating significant differences between the normalized factor scores for additional reliability. Table 10 tabulates the values of standard errors for difference. The diagonal entries in Table 10 are *SE* within factors.

Table 10

Standard Errors for Differences in Factor Z-Scores for the Comprehensive Group

Factor	Factor 1	Factor 2	Factor 3
1	0.181	0.226	0.237
2	0.226	0.263	0.273
3	0.237	0.273	0.283

Factor analysis for the comprehensive group (all participants including users and nonusers of EHR) revealed three factors influencing the EHR adoption in the physician community belonging to smaller practices. The three factors were (a) sensitivity for technology, time, and change for autonomy redistribution; (b) sensitivity toward finance, organizationally favorably positioned for innovativeness, and mixed propensity for technology and change of autonomy redistribution; and (c) sensitivity for technology, insensitivity to finance as well as to change in autonomy redistribution, and propensity of organizational culture and support.

The third step, interpretation of the factors, was one of the most important steps in the analysis of Q-methodology data. The factor scores and difference scores supported the interpretation and description of the factors. The factor scores and difference scores generated by PQMethod 2.20 software (Schmolck, 2011) helped in the interpretation of factors for this study. Z-Scores represented the normalized scores or transformed raw scores to help factor and correlational analysis (Kline, 1994, p. 16). van Exel and de Graaf (2005) further explained the factor score as being the normalized weighted average score for each statement for the respondent representing that factor . Z-Score = (raw score – mean of the group) divided by the standard deviation (Kline, 1994, p. 17). Table 11 lists the Z-Scores for each statement in relation to each factor for the comprehensive group of respondents.

Table 11

Factor Scores With Corresponding Ranks for the Comprehensive Group

	Factor					
	1		2		3	
No.	Factor score	Rank	Factor score	Rank	Factor score	Rank
1	0.79	12	1.39*	5	-0.88	40
2	0.20	25	-0.29	29	1.46*	3
3	-0.35	33	-1.61**	49	1.32*	8
4	0.91	11	-0.9	37	-0.70	38
5	0.57	15	-0.99	38	-0.16	29
6	0.36	19	0.44	22	0.59	14
7	0.99	9	0.76	12	1.71*	2
8	1.62*	3	1.49*	4	0.33	22
9	-0.99	39	-0.75	35	0.72	11
10	-0.83	36	-1.26**	45	-0.92	41
11	-1.30**	45	-0.88	36	0.26	23
12	-2.01**	50	-1.24**	44	-2.29**	50
13	0.96	10	-1.15**	41	-0.63	37
14	-0.14	30	0.39	23	0.56	16
15	-0.35	34	-1.85**	50	-0.33	32
16	-0.11	29	-0.53	34	0.57	15
17	0.32	20	1.11*	7	0.52	17
18	0.00	28	-0.33	30	0.11	24
19	-0.19	31	0.16	26	0.88	10
20	1.02*	8	0.57	18	1.43*	4
21	-1.33**	46	-1.27**	46	-0.94	42
23	-1.82**	49	-0.47	33	-0.96	43
24	-0.83	37	0.57	17	1.34*	7
25	0.50	16	0.25	25	-0.61	36
26	0.21	23	0.93	9	0.34	21
27	-0.28	32	-1.19**	42	0.71	12
28	0.74	14	1.55*	3	1.13*	9
29	1.39*	6	1.65*	2	-0.16	28
30	1.04*	7	0.82	11	0.68	13
31	1.68*	1	1.78*	1	0.36	20
32	-1.58**	48	-1.15**	40	-1.72**	48

	Factor					
	1		2		3	
No.	Factor score	Rank	Factor score	Rank	Factor score	Rank
33	-0.50	35	0.64	16	0.45	19
34	1.50*	5	0.87	10	-1.28**	45
35	1.59*	4	0.00	28	1.39*	6
36	-1.21**	44	-0.46	32	-0.06	26
37	1.63*	2	0.45	21	-0.44	34
38	0.31	21	0.52	19	-0.18	30
39	0.45	18	0.36	24	1.42	5
40	0.05	27	0.67	14	1.73*	1
41	-1.21**	43	1.09*	8	-1.80**	49
42	-1.09**	41	-1.52**	48	-1.63**	47
43	-1.57**	47	0.49	20	-1.46**	46
44	-1.19**	42	1.37*	6	-0.81	39
45	0.13	26	0.68	13	-0.53	35
47	-0.84	38	-1.21**	43	-0.08	27
48	0.47	17	-1.31**	47	-0.03	25
49	0.29	22	0.64	15	-0.27	31
50	0.75	13	0.14	27	0.50	18

Note. Z-scores with one asterisk (*) indicate greater Q-sort agreement and Z-scores with two asterisks (**) indicate greater Q-sort disagreement with statements relative to each factor. For complete statements, see Appendix B.

The Z-Scores defined the assignment of statements in a quasi-normal distribution, resulting in an idealized Q-sort for each factor. The idealized Q-sort is also known as the comprehensive Q-sort. Thus, the ideal Q-sort is based on the Z-Scores that represent a hypothetical respondent's loading at 100% on a particular factor. The statements with Z-Scores higher than 1 and less than -1 characterize the factor, thus a comparison of the loading with each factor defined the significant relationships. The defining variables of Q-sorts used a confidence level of 99% or $p < 0.01$ (van Exel & de Graf, 2005). Each factor had prominent statements selected on the basis of factor scores. The interpretation of the factors included the factor Q-sort value, Z-Scores, and distinguishing statements. The prominent statements at the extreme ends of the factor sorts determined the perspectives underlying each factor.

Factor 1: Comprehensive

The largest variance of 20% was reflected through opinions and perspectives on adoption and acceptance of EHR systems associated with Factor 1. Factor 1 related to attributes of technology, time efficiencies, and changes with autonomy distribution. The physicians had technical, time-related, and autonomy-related barriers dominated their perspectives. Factor 1 had neutrality for the organizational attribute. There were 22 participants (see Table 7) who loaded on this factor at a level of 95% significance for values greater than 0.28 ($p < 0.05$, Equation 2). Out of 22, 17 participants loaded at 99% significance for values greater than 0.37 ($p < 0.01$, Equation 3). One out of the 22 had a negative association with this factor.

There were 19 distinguishing statements associated with Factor 1 at a confidence level of 95% ($p < 0.05$). Out of the 19 statements, 13 were significant at the 99% confidence level ($p < 0.01$). Table 12 provides the top distinguishing statements, whereas Table 13 provides all the distinguishing statements for this factor. Of these 13 statements, one statement each ranked at +5 and+4, and two statements ranked at +3 level of ratings (see Tables 12 and 13). The two out of the four positively ranked distinguishing statements related to the issue of complexity in the EHR technology selection, installation, and maintenance process. Furthermore, it communicated the level of involvement needed from the medical practitioner in the technical area unrelated to his or her core expertise. Statements with a rating of +5 and +4 for Factor 1 were Statements 37 and 34 (see Tables 12 and 13). Statement 37, "Capacity within my practice to select, install, and contract for an EHR system is (has been) a major concern," highlighted the concern of bringing the right system into the practice or office without having an expert system analyst on the payroll. Statement 34, "Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system," further supported the perspective that EHR systems encroached on time spent for medical purpose.

Table 12

Top Sort Ranking of Distinguishing Statements for Factor1 for the Comprehensive Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
37	Capacity to select, install, and contract for an EHR is a concern.	5	1.63*
34	Physicians time to deal with the technology directly without the needed expertise.	4	1.50*
13	EHR leads to excessive use of guidelines threatening professional autonomy.	3	0.96*
4	Loss of professional autonomy adds resistance to adoption of EHR.	3	0.91*
41	It is easy for me to become skillful in the use of EHR technology.	-3	-1.21
36	It is easy for staff to prepare and submit patient evaluations with EHR.	-3	-1.21*
23	Time and quality of face-to-face communication with patients is the same as without computer use.	-5	-1.82*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Table 13

All Distinguishing Statements for Factor 1 for the Comprehensive Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
37	Capacity to select, install, and contract for an EHR is a concern.	5	1.63*
34	Physicians time to deal with the technology directly without the needed expertise.	4	1.50*
13	EHR leads to excessive use of guidelines threatening professional autonomy.	3	0.96*
4	Loss of professional autonomy adds resistance to adoption of EHR.	3	0.91*
1	The amount of capital requirement and availability is an adoption barrier	2	0.79*
5	Small financial incentives modify EHR adoption behavior.	2	0.57*
48	EHR may decrease professional discretion over patient-care decisions.	1	0.47
46	I may not have the needed training to change from paper-chart to EHR processes.	0	0.20
2	Small operating margins demand efficient work routines in practice.	0	0.20
45	Management's response to training is critical for EHR implementation success	0	0.13
40	A team approach serves for workflow effectiveness with EHR technology.	0	0.05*
14	A standalone EHR system has issues of interconnectivity among medical offices for data integration.	-1	-0.14
27	The CMS pay-for-performance demonstration has prompted practices positively.	-1	-0.28*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	-1	-0.35*
33	Analysis of needs and preferences leads to timely conversion to EHR data.	-2	-0.50*
24	Information from physicians from EHR adopters is helpful to other physicians.	-2	-0.83*
41	It is easy for me to become skillful in the use of EHR technology.	-3	-1.21
36	It is easy for staff to prepare and submit patient evaluations with EHR.	-3	-1.21*
23	Time and quality of face-to-face communication with patients is the same as without computer use.	-5	-1.82*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Statement 41 with a rating of -3, "It is easy for me to become skillful in the use of EHR technology," reinforced the belief that challenges with technology defined the adoption and acceptance perspectives for this group of physicians. The agreed-with high Z-Scores for the technology barriers were demonstrated by Statements 37 and 34, whereas Statement 43 had high disagreed-with Z-Scores (see Appendix D). Statement 43, "Learning to operate the system was (will be) easy for me," highlighted the viewpoint that operating the EHR system could have a steep learning curve for some physicians. This illustrated a desire for the PEOU attribute. In a nutshell, the Factor 1 perspective expressed the belief that the EHR systems were not simple and required dedicated time and effort to establish an expected level of efficiency.

Table 14

Participant Comments for Factor 1 for the Comprehensive Group

No.	Statement (abbreviated)	Comment
23	Time and quality of face-to-face communication with patients is the same as without computer use.	The system is not designed to improve communication with patients, nor their providers. (Participant: A1147)
34	Physicians time to deal with the technology directly without the needed expertise.	IT support is expensive and the EMR support team does not want to give you any long term or in-depth training. (Participant: A1111)
37	Capacity to select, install, and contract for an EHR is a concern.	More resources have been required to support the system. (Participant: A1150)

Note. EHR = electronic health record.

Similarly, of these 13 distinguishing statements, one statement ranked at -5 and two at -3 levels of ratings (see Table 13). The two distinguishing statements with high negative ratings related to the time or tempo attribute. The most disagreed-with statement was distinguishing Statement 23 with a Q-sort value of -5 (see Tables 12 and 13), which focused on increased time taken to communicate with the patient personably. As observed, the level of satisfaction in physician-patient encounters greatly depends on the communication among the involved parties; the use of EHR system bulk of time requires extra time for a personal and amiable interaction. The face-to-face communication in the paper-chart environment had greater personal touch and had a lesser time requirement when compared to EHR system. The negative ranking for the distinguishing Statement 23, “There is a positive impact on the quality of communication with patients in the same amount of time when compared to paper charts,” was evident by participants’ comments listed in Table 14. Physicians spend a considerable percentage of time entering data into the system than having a meaningful dialogue with the patient.

The distinguishing Statement 36, negatively rated at -3, reflected on the time barrier. It associated with the ease of use attribute of the system in preparing and submitting patient evaluations. The perspective on ease of use of the system was further supported by Statement 35 (see Appendix D) with a high agree-with Z-Score. Statement 35 stated, “Using the system requires a lot of extra effort in my practice. The researcher needed more employees than before to complete the same types of clinical tasks,” resulting in increased use of resources of physicians or support staff employees. Physicians required additional time to simultaneously navigate through the interface of the system and communicate amiably with patients. The perceived usefulness of the EHR system might be at a disputer for Factor 1 participants.

Factor 1 showed neutrality toward organizational attributes. The neutrality was evidenced through distinguishing Statements 40, 45, and 46. Statement 45, “Top management’s response to training for EHR has been critical to the success of EHR implementation”; Statement 40, “My staff and I understood that a team approach would best serve the work flow effectiveness when using an EHR technology”; and Statement 46, “I may not/did not receive essential guidance or explanation on how to adopt paper-based processes into the EHR environment,” rated at a score of 0, reflecting Factor 1 respondents were more focused on the technological and time issues rather than the organizational structure, support, and culture required for the technological innovations.

Although there was neutrality for organizational attributes, Statement 44 (see Appendix D), “I like to experiment with new information technologies,” represented high disagreement in the Factor 1 group. The culture of innovation within the domain of information technology was not represented by the Factor 1 group. This statement was contraindicative of the neutrality for the organizational attribute. The third most agreed-upon statement based on the Z-Score for Factor 1 was Statement 31 (see Appendix D), “Loss of short-term productivity is a major concern during the transition,” suggested an association to the financial barrier.

The third attribute represented by Factor 1 was related to a change in autonomy distribution. Factor 1 embraced in their perspective that electronic record keeping would make third parties more intrusive, thus leading to higher levels of administrative scrutiny. This attribute was evident in the distinguishing Statements 13 and 4 with a rating of +3 (see Table 13).

Factor 2: Comprehensive

Factor 2 explained 13% of the variance across respondents’ perspectives in smaller medical practices. The attributes reflected in Factor 2 were sensitivity to finance, organizationally favorably positioned for innovativeness, and a mixed propensity for technology and change in autonomy redistribution. Factor 2 had 15 participants loading at a significance level of 95% ($p < 0.05$) at values greater than 0.28, Equation 2. Fourteen of the 15 participants loaded at a significance level of 99% ($p < 0.01$), for values greater than 0.37, Equation 3 (see Table 7). All participants had a positive association with the factor. Four out of the 15 had high positive correlation values between 0.60 and 0.80. There were 20 distinguishing statements for Factor 2 at a significance level of 95% ($p < 0.05$). Fifteen out of the 20 statements had a significance of 99% ($p < 0.01$). Of those, two distinguishing statements each ranked positive at +4 and +3 rating at a significance level of 99%. The two statements were associated with the technology attribute. Distinguishing Statement 41, "It is easy for me to become skillful in EHR technology," scored +3 rating and high agree-with Z-Score. Distinguishing Statement 34 with a +3 rating supported the viewpoint that physicians should not distract from their core medical expertise with information technology-related tasks.

Technology-related issues were seen in the perspectives of Factor 2 physicians through a high positive Z-Score for Statement 17. Statement 17, "Lack of uniform data standards for the industry makes exchange of data difficult. My staff and I work with a number of separate portals to gather data as EHR to EHR interconnectivity is not available," stressed how physician offices struggle with connectivity issues of the technology for data sharing and exchange. This opinion was further supported with distinguishing Statement 15 rated with a -5 and a high disagree-with Z-Score. Statement 15, "The ability to interface with hospitals is the biggest advantage of EHR system for our office," suggested that independent smaller practices faced technical challenges when trying to interface with local area hospitals.

Theoretically, Statements 17 and 15 confronted physicians with technology compatibility, complexity, and concerns for perceived usefulness in acceptance and diffusion of EHR systems. Although technology was a challenge for both Factor 1 and Factor 2 physicians, the Factor 2 individuals had system-related concerns. They did not feel overwhelmed with acquiring the technical skills.

Factor 2 respondents related to the financial attribute with sensitivity. Distinguishing Statement 3, “Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians,” scored a -5 and a high disagree-with Z-Score (see Table 15). A rating of +4 and high positive Z-Score for distinguishing Statement 1, “The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier,” emphasized that the large price tag for the technology was a burden for physicians, and this burden was not subsidized by declared incentives for this group of physicians.

Statement 44, “I like to experiment with new information technologies,” scored a high rating of +4 along with a high agree-with Z-Score. The statement emphasized this trait at a personal level or driven by organizational culture of innovation. Additionally, Factor 2 showed neutrality toward the time and tempo barrier. In sum, Factor 2 respondents were more confident about acquiring the skills to work with the system, the time constraint associated with tasks showed neutrality. The neutrality of the statements was evidenced through Statement 35, “Using the system requires a lot of extra effort in my practice. I needed more employees than before to complete the same types of clinical tasks," rated at a 0 score. Table 15 lists all the distinguishing statements for Factor 2. Fifteen were significant at $p < (0.01)$ and are denoted with an asterisk (*).

Table 15

All Distinguishing Statements for Factor 2 for the Comprehensive Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
1	The amount of capital requirement and availability is an adoption barrier.	4	1.39*
44	I like to experiment with new information technologies.	4	1.37*
17	Lack of industry standards for an EHR system results in the use of separate portals to gather data by the staff.	3	1.11
41	It is easy for me to become skillful in the use of EHR technology.	3	1.09*
26	There is a need for a buy-in by staff to make them willing to accept the change.	3	0.93
34	Physicians time to deal with the technology directly without the needed expertise.	3	0.87*
45	Management's response to training is critical for EHR implementation success.	2	0.68
40	A team approach serves for workflow effectiveness with EHR technology.	2	0.67*
24	Information from physicians from EHR adopters is helpful to other physicians.	1	0.57*
20	EHR implementation with a project team adds cost in the adoption process.	1	0.57
43	Learning to operate the system was (will be) easy for me.	1	0.49*
37	Capacity to select, install, and contract for an EHR is a concern.	1	0.45*
35	An EHR system requires extra time thus needs more employees for the same amount of work.	0	0.00*
2	Small operating margins demand efficient work routines in practice.	-1	-0.29
5	Small financial incentives modify EHR adoption behavior.	-2	-0.99*
27	The CMS pay-for-performance demonstration has prompted practices positively.	-3	-1.19*
12	Using EMR enables me to complete patient encounters more quickly.	-3	-1.24*
48	EHR may decrease professional discretion over patient-care decisions.	-4	-1.31*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	-5	-1.61*
15	Interfacing with hospitals is an advantage of EHR for our medical office.	-5	-1.85*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

The negative Z-Scores representing disagreement by respondents were evident through Statements 47 and 48 (see Appendix E). Statement 47, "EHR systems may help laypersons and subordinate paraprofessionals gain greater access to the abstract knowledge possessed by physicians which is helpful to my practice," received high negative Z-Scores. This statement suggested that physicians in smaller practices, especially in general specialties, feared autonomy redistribution if some procedures were treated by the paraprofessional with the aid of decision support systems in the future.

Table 16

Top Sort Ranking of Distinguishing Statements for Factor 2 for the Comprehensive Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
1	The amount of capital requirement and availability is an adoption barrier.	4	1.39*
44	I like to experiment with new information technologies.	4	1.37*
17	Lack of industry standards for an EHR system results in the use of separate portals to gather data by the staff.	3	1.11
41	It is easy for me to become skillful in the use of EHR technology.	3	1.09*
26	There is a need for a buy-in by staff to make them willing to accept the change.	3	0.93
27	The CMS pay-for-performance demonstration has prompted practices positively.	-3	-1.19*
12	Using EMR enables me to complete patient encounters more quickly.	-3	-1.24*
48	EHR may decrease professional discretion over patient-care decisions.	-4	-1.31*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	-5	-1.61*
15	Interfacing with hospitals is an advantage of EHR for our medical office.	-5	-1.85*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

A high disagreement for Statement 48, “Using the EHR may decrease my professional discretion over patient care decisions,” suggested a contrary belief for Statement 47 (see Appendix E). Factor 2 physician respondents had mixed reactions to issues of change in autonomy distribution. Table 16 lists the most significant statements of Factor 2, the financially and technology sensitive perspective. The loadings suggested that physicians comprising this factor would learn the skills of the EHR technology to serve their patients better.

Although respondents comprising Factor 2 were open to learning the technology’s interface, they were dissatisfied with the standards of the current technology’s interface for communication of information. Physicians willing to use the EHR system were wary of the fact that systems adopted by different facilities serving their patients had interfaces that did not allow easy sharing of patient data. The respondent comments suggested that independent medical practitioners were dissatisfied with the level of standardization of communication between systems (see Table 17). Statements 17 and 15 suggested that the compatibility expectations were not satisfactorily met.

Table 17

Participant Comments for Factor 2 for the Comprehensive Group

No.	Statement (abbreviated)	Comment
1	1. The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier.	Between the software, hardware, upgrading, adding wireless nodes, and training time, we have spent in excess of 150,000.00 for a 2 doctor practice. (Participant: A1147) In an office with small operating margins, cost is everything. (Participant: A1144) Reimbursement is already low and we don't have money to devote to something which will just make us less productive. (Participant: A1124) It is not affordable for a small practice to acquire and maintain an EHR system comparable to the ones used in hospital systems that are very expensive. (Participant: A1123)
15	The ability to interface with hospitals is the biggest advantage of EHR systems for our office.	The hospitals won't buy the HL-7 interlink Patch. I work with 3 different hospital systems with Meditech, Cerner, and Epic. I have no interconnectivity (Participant: A1147) Interfaces are cumbersome if not non-existent in most practice areas outside of hospital systems and university settings (Participant: A1123)
44	I like to experiment with new information technologies.	I have worked with the development of computers since the 70's and find learning new processes mentally invigorating. (Participant: A1142) I enjoy using new tech and learning how things work, my partner is computer illiterate. (Participant: A1134) I have written software and statistical studies, so I am an early adopter of most technologies. (Participant: A1117)

Note. EHR = electronic health record.

Factor 3: Comprehensive

Technology and time sensitivity, insensitivity to barriers of finance and change in autonomy redistribution, and propensity for strong organizational culture and support were reflected in Factor 3 perspectives. Factor 3 explained 11% of the total variability. Seventeen participants loaded on this factor at a level of 95% significance with a value greater than 0.28 ($p < 0.05$) as per Equation 2; 11 out of 17 loaded on this factor were at a significance level of 99% with values greater than 0.37 ($p < 0.01$) as per Equation 3. Factor 3 had 25 distinguishing statements associated with it at a confidence level of 95% ($p < 0.05$). Twenty-one out of 25 statements associated with this factor were significant at a 99% ($p < 0.01$) confidence level. Of those 21 statements, three statements, 40, 2, and 7, had an agree-with rating of +5. Statement 39 had a rating of +4, and Statements 24, 3, and 19 had a score of +3 (see Table 18).

The positive statements associated the organizational attribute with Factor 3 for effective adoption and implementation of the EHR system. As suggested by distinguishing Statement 40, "My staff and I understood that a team approach would best serve the work flow effectiveness when using an EHR technology," and distinguishing Statement 19, "A physician's own practice group as an organization influenced the EHR adoption decisions more than an external agency," with ratings of + 5 and +3, respectively, that the organizational attribute was critical for adoption. Respondents believed that system success was critically influenced by an organizational culture of agile structure and internal support.

Table 18

Distinguishing Statements for Factor 3 for the Comprehensive Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
40	A team approach serves for workflow effectiveness with EHR technology.	5	1.73*
7	Data conversion from paper to electronic charts is time-consuming.	5	1.71*
2	Small operating margins demand efficient work routines in practice.	5	1.46*
39	EHR technology requires physicians and their assistants to align their clinical work flows with the system through software interface.	4	1.42*
24	Information from physicians from EHR adopters is helpful to other physicians.	3	1.34*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	3	1.32*
19	A physician's own practice group influenced the EHR adoption.	3	0.88*
9	Estimation of time required to convert to electronic records is a challenge.	3	0.72*
27	The CMS pay-for-performance demonstration has prompted practices positively.	2	0.71*
16	My practice is aware and supportive of techno-phobic employee needs.	2	0.57*
31	Loss of short-term productivity is a major concern.	1	0.36*
8	Physicians face lack of time to acquire knowledge of EHR system.	1	0.33*
11	Universal EHR implementation would enhance healthcare quality.	0	0.26*
48	EHR may decrease professional discretion over patient-care decisions.	0	-0.03
47	Concerns exist for the standalone EHR system's obsolescence and future data migration.	0	-0.08*
29	Loss of long-term productivity is a major concern during the transition.	0	-0.16*
5	Small financial incentives modify EHR adoption behavior.	-1	-0.16*
38	CCHIT EHR vendor's longevity in market is a concern.	-1	-0.18
49	Concerns exist for the standalone EHR system's obsolescence and future data migration.	-1	-0.27
37	Capacity to select, install, and contract for an EHR is a concern.	-1	-0.44*
45	Management's response to training is critical for EHR implementation success	-2	-0.53*
25	The way the system is designed is inconsistent with how I like to conduct medical evaluations.	-2	-0.61*
1	The amount of capital requirement and availability is an adoption barrier.	-3	-0.88*
34	Physicians time to deal with the technology directly without the needed expertise.	-4	-1.28*
41	It is easy for me to become skillful in the use of EHR technology.	-5	-1.80

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services; CCHIT = Certification Commission for Healthcare Information Technology. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

A negative rating of -5 for Statement 41 at 95% significance, “It is easy for me to become skillful in EHR technology,” and at a 99% significant score of -4 for Statement 34, “Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system,” suggested that Factor 3 respondents’ viewpoints included concerns about learning skills unrelated to their core expertise of medicine. Statements 42 and 43 supported the operational concerns with the technology skills illustrated with high disagreement Z-Scores. Two statements, “I can use the system easily while I perform a medical evaluation procedure” and “Learning to operate the system was (will be) easy for me,” stated this concern.

The financial insensitivity was evident in the perspectives of Factor 3 respondents. The unconcern for financial factor was demonstrated by distinguishing Statements 2 and 3. Statement 2, “A smaller operating margin related to EHR (electronic health record) adoption requires higher efficiency expectancy in all administrative and clinical work routines,” with a rating of + 5 suggested that this group was aware of narrowing reimbursement for medical procedures and proposed administrative and clinical efficiencies to combat it. Additionally, the belief of needing a large sum of capital to invest in the technology as a barrier received a negative rating of -3 for distinguishing Statement 1. Furthermore, “Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians,” was positively associated with a high agree-with Z-Score and a rating of +3. Factor 3 respondents did not seem to be threatened with redistribution of autonomy issues (see Table 18).

The top distinguishing statements at the 99% confidence level are listed in Table 19. The Factor 3 physicians presented the viewpoint that supported the importance of organizational factors in overcoming challenges related with acceptance and diffusion of the EHR technology. The time- and tempo-related migration barrier was evident through Statements 7 and 9 stating conversion of information from paper charts to electronic format was a time-consuming and cumbersome process (see Table 19).

The high negative Z-Scores for Statements 41 and 12 (see Appendix F) suggested that specialized skills and associated time concerns could be combated with organizational support and agile structure of teams. The comments relating to such observations are provided in Table 20.

Factor Differences

The factor description included difference scores between defining statements of the factors. The difference score explained the statistically significant difference in magnitude of score between determining statements on any two factors. A difference of two or higher between two factor scores on a statement is significant (van Exel & de Graaf, 2005; S. Brown, 1993). The statements with two and higher difference scores for the comprehensive group (users and nonusers of EHR) are discussed in the following paragraphs to highlight the distinctive statements between any two factors.

Table 19

Top Sort Ranking of Distinguishing Statements for Factor 3 for the Comprehensive Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
40	A team approach serves for workflow effectiveness with EHR technology.	5	1.73*
7	Data conversion from paper to electronic charts is time-consuming.	5	1.71*
2	Small operating margins demand efficient work routines in practice.	5	1.46*
39	EHR technology requires physicians and their assistants to align their clinical work flows with the system through software interface.	4	1.42*
24	Information from physicians from EHR adopters is helpful to other physicians.	3	1.34*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	3	1.32*
19	A physician's own practice group influenced the EHR adoption.	3	0.88*
9	Estimation of time required to convert to electronic records is a challenge.	3	0.72*
1	The amount of capital requirement and availability is an adoption barrier.	-3	-0.88*
34	Physicians time to deal with the technology directly without the needed expertise.	-4	-1.28*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Differences Between Factors 1 and 2: Comprehensive

Statement 13 showed significant difference scores between the two factors (see Appendixes G and H). On the comparison of the two factors, the Factor 1 group presented with concerns about barrier of autonomy redistribution. This perspective found a higher degree of restriction in decision making through stringent guidelines with the adoption of EHR technology. Statement 13, "EHR software leads to excessive use of guidelines, therefore, it is threatening to my professional autonomy," was ranked +3.

Table 20

Participant Comments for Factor 3 for the Comprehensive Group

No.	Statement (abbreviated)	Comment
24	Information and support from physicians who are already EHR users have been very helpful. It was (is going to be) instrumental in my selection of the system.	One looks for guidance from one's friends or peers who have successfully gone thru the process.(Participant: A1114) When we selected a system for ophthalmology, we wanted an experienced EHR vendor with many installations we could see in operation. (Participant: A1117)
39	I am aware that an EHR technology requires physicians and their assistants to align their clinical work flows with the system; the selected system provided the interface to include important workflows.	The selected system did not address workflow needs of the various users and we are unable to understand the process in our office. (Participant: A1135)
34	Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system.	IT support is expensive and the EMR support team does not want to give you any long term or in-depth training. (Participant: A1111)
12	Using EMR enables me to complete patient encounter more quickly.	We are much slower (it takes 2x as long to see patients) (Participant: A1117)
41	It is easy for me to become skillful in the use of EHR technology.	I have no time to experiment with the system and nobody is available to help me. (Participant: A1122)

Note. EHR = electronic health record.

The physician group in Factor 1 believed that electronic format of records would lead to increased oversight by insurance and other governing bodies and, therefore, was a barrier. This barrier suggested an impact on the relative advantage in a diminishing way for acceptance of the EHR technology. The Factor 2 physicians had an opposite viewpoint with a ranking of -3 regarding autonomy redistribution and EHR usage.

Furthermore, Statements 41, 43, and 44, "It is easy for me to become skillful in the use of EHR technology," "Learning to operate the system was (will be) easy for me," and "I like to experiment with new information technologies," respectively, added significant distinction between the perspectives held by the respondents of the two factors. Factor 1 negatively factored the personal trait of trying new technologies, implying that individuals representing this perspective did not thrive in or support the culture of innovativeness as an organizational factor. Similarly, Factor 1 respondents believed operating the new system and acquiring the skills is a challenge for them. They represented a "techno-stressed personality." The rankings assigned by Factor 1 respondents to Statements 41, 43, and 44 were -3, -4, and -3, respectively. The negative rankings suggested a strong expectancy with the ease of use determinant of a technical system. Furthermore, these individuals did not have the traits of a technology fervent.

Factor 2 respondents aligned with traits of a believer of the technology innovativeness at a personal level. They showed an interest in learning the technology at a personal level and enjoyed a culture of innovation in the domain of information technology (PIIT). The Factor 2 respondents gave rankings of 3, 1, and 4 for Statements 41, 43, and 44.

Differences Between Factors 1 and 3: Comprehensive

Statements 34 and 37 showed a significant difference between Factors 1 and 3 (see Appendix G and I). The belief underscoring the two statements dispensed that physicians do not have expertise in the domain of technology and needed intensive support both internally and externally during the technical system's life cycle. Factor 1 respondents were apprehensive about selection, installation, and implementation of the system. Statement 34, “Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system,” and Statement 37, “Capacity within my practice to select, install, and contract for an EHR system is (has been) a major concern,” ranked + 4 and +5 (see Appendix G), respectively, in rankings from Factor 1 physicians. Even though Factor 3 respondents found technology a challenge, they disagreed with Statement 34 with a ranking of -4 (see Appendix G), which is conflicting. An explanation could be that physicians of Factor 3, having confidence for organizational support and its role in technology acceptance and diffusion, believed that a team member could perform system analysis and selection even though their core expertise is not technology. Factor 3 respondents were neutral with a ranking of -1 for Statement 37 for a similar reason.

Statement 24, “Information and support from physicians who are already EHR users has been very helpful. It was (is going to be) instrumental in my selection of the system,” suggested that the organizationally driven Factor 3 respondents believed in using the experiences of other early adapters in making decisions pertaining to writing contracts, selection, and installation of systems. The Factor 1 respondents, being fearful of the technology domain, did not confidently seek their peers’ advice during system adoption and use.

Differences Between Factors 2 and 3: Comprehensive

Statements 1, 41, and 44 showed significant difference of scores between Factors 2 and 3 (see Appendixes G and J). The ranking of +4, +3, and +4, respectively, for each statement suggested that, as believers of trying and acquiring new technology skills (Statement s41 and 44), the Factor 2 group of physicians was conscious of the capital needs required for the adoption and maintenance of the technology. Statement 1, “The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier,” with a rank score of +4 suggested that physicians who were skillful at trying and learning a new technology did not approve of the ticket price attached to the technology, whereas Factor 3 physicians were not as concerned with the financial factor. A -3 ranking for Statement 1 by Factor 3 physicians suggests price insensitivity.

Statement 3, “Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians,” ranked a -5 with Factor 2 physicians and +3 with Factor 3 physicians (see Appendix G). The Factor 2 respondents believed that there should be substantial financial advantages associated with the EHR system for adoption and acceptance, whereas Factor 3 respondents believed otherwise.

Consensus Statements for All Respondents

The consensus statements describe the similarities among the factors (van Exel & de Graaf, 2005). These statements are indistinguishable between any pair of factors. Table 21 lists the consensus statements among the three factors. The similarly ranked statements from physicians categorized into all three factors. Statement 32 related to the expectation that EHR technology would increase the overall productivity. The statement commonly had a negative ranking of -5, -3, and -5 at a significance level of $p < 0.01$. The cost associated with security and confidentiality of medical information was one of the concerns among physicians as presented in Statement 30. Statement 30 was rated at +3, +3, and +2 among the three factors at a significance level of $p < 0.05$. Statement 6 regarding the uncertainty for rate of return had neutral ratings of +1, +1, and +2 (see Table 21).

Table 21

Consensus Statements for the Comprehensive Group

		Factor					
		1		2		3	
No.	Statement	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
6*	Uncertainty about return on investment is a major barrier.	1	0.36	1	0.44	2	0.59
10*	All stakeholders promoting EHR are focused on quality with limited resources.	-2	-0.83	-4	-1.26	-3	-0.92
18*	Human and organizational issues are reasons for failure of EHR implementation.	0	0.00	-1	-0.33	0	0.11
21*	EMR use is easy in patient care and management.	-4	-1.33	-4	-1.27	-3	-0.94
22*	It has been easy to tailor the system to how my practice handles reports.	-3	-1.00	-2	-1.11	-3	-1.27
30*	Confidentiality and security are costly to install and maintain.	3	1.04	3	0.82	2	0.68
32	Using the EHR system will (has) increase(d) my productivity.	-5	-1.58	-3	-1.15	-5	-1.72
38	CCHIT EHR vendor's longevity in market is a concern.	1	0.31	1	0.52	-1	-0.18
42	I can use the system easily while I perform a medical evaluation procedure.	-3	-1.09	-5	-1.52	-4	-1.63
46	I may not have the needed training to change from paper-chart to EHR processes.	0	0.20	-1	-0.35	-1	-0.36

Note. EMR = electronic medical record; EHR = electronic health record; CCHIT = Certification Commission for Healthcare Information Technology. Consensus statements are those that do not distinguish between any pair of factors. All listed statements are nonsignificant at $P > .01$, and those flagged with an * are also nonsignificant at $P > .05$.

Statement 46, "I may not/did not receive essential guidance or explanation on how to adopt paper-based processes into the EHR environment," was rated in the neutral rankings of 0, -1, and -1 at a significance level of $p < 0.01$for all three factors. Similarly, Statement 18, "The most common reason for failure of implementation is that the implementation process is treated as a technological problem; human and organizational issues are not fully addressed," had neutral ratings of 0, -1, and 0 at a significance level of $p < 0.05$. Statement 10 suggested that the role of external agencies like CMS, CCHIT, health information technology extension centers were not looked at as receptive bodies for physician causes. Statement 10 rated at -2, -3, and -4 among the three factors. The role of external stakeholders was perceived more negatively by all three factors.

Physicians in general found the system's interface did not give them the ability to complete the medical record in efficient steps, thus rated Statement 42 with -3, -5, and -4 ($p < 0.01$). The statement regarding finding a Certification Commission of Health Information Technology-certified EHR being a concern as there had been so many vendors in the market and there was no way of knowing which of these vendors would be in existence after 10 years was rated more neutrally with rankings of +1, +1, and -1 among the three factors.

Statements 21 and 22 related to issues of change in processes related to work practices needed with EHR system implementation. Statement 21 rated at -4, -4, and -3, and Statement 22 rated with rankings of -4, -3, and -2 showed an agreement among all respondents that these were common challenges faced by all medical specialties in small practices.

Result Summary for All Physicians: Comprehensive Group

Physicians in independent practices showed different attitudes toward the five barriers of adoption and diffusion. The Factor 1 physicians presented with concerns for technology, time, and autonomy redistribution. The Factor 2 physicians showed financial sensitivity, technical skills enthusiast with concerns at the system level, a supporter of the culture of innovativeness, and insensitivity for autonomy redistribution. Factor 3 physicians presented sensitivity to technology, believed in the role of organizational factors, and had a lack of concern for financial elements.

Next, this study embarked to learn the attitudes of physicians based on whether they had been the users of the EHR system or were the nonusers of the system. The analysis of attitudes toward adoption related with nonusers of the system, whereas the analysis of attitudes toward acceptance and diffusion of the system related those of the user group. A comparison of the two groups helped answer the research questions of this study.

Factor Analysis of Nonusers of an EHR System

A similar type of factor analysis was performed using PQMethod 2.20 software (Schmolck, 2011) for the respondents who were not using any EHR system at the time of the data collection but were in the process of adopting the technology within 24 months. The nonuser participant set or P-set was composed of 15 respondents. The data were analyzed using the same set of 50 Q-statements. As with the comprehensive group, a determination of significance at the level of 0.01 level or 99% and at the level of 0.05 or 95% was made to eliminate the likelihood of having the correlation happen by chance for the nonuser group of the EHR system (Kline, 1994). A correlation of 95% confidence level was where $p < .05$, Equation 2, represented by the value greater than 0.28, whereas a 99% confidence level where $p < (.01)$ resulted in values greater than 0.37, Equation 3.

PCA using a correlational matrix with 15 variables determined the patterns of perspectives that existed among the subset of respondents who were nonusers of EHR technology (J. Brown, 2009). The correlational matrix for nonusers of EHR system is listed in Appendix K. Next, principle component analysis determined the unrotated eight factors with eigenvalues (see Appendix L). The third step undertook varimax rotation to maximize the relationship among variables. The variables that loaded high on a factor defined the factors. Table 22 shows the factor loadings for each variant using PQMethod 2.20 (Schmolck, 2011). Based on the nontrivial test criteria, the absolute value of the loadings for nonusers of an EHR system presented the three factors. Factor 1 and 3 were less trivial than Factor 2.

Table 22

Factor Matrix With the Defining Sort Loadings for the Nonuser Group

		Loading		
No.	Q-sort	1	2	3
1	A1114N1	0.0387	0.6720XX	-0.1465
2	A1116N2	0.2723	0.6177XX	0.0569
3	A1120N3	0.5731XX	0.1049	0.1848
4	A1123N4	0.0440	0.0257	0.7700XX
5	A1124N5	0.6793XX	0.0653	0.3498##
6	A1126N6	0.7351XX	0.2094	-0.3024##
7	A1128N7	0.0149	0.5854XX	0.3544##
8	A1130N8	0.6885XX	0.3461##	0.0525
9	A1131N9	0.5895XX	0.3832XX	0.3394##
10	A1132N10	0.4802XX	0.2377	0.4967XX
11	A1134N12	0.1264	-0.0509	0.7316XX
12	A1140N13	0.7141XX	0.2580	0.0723
13	A1145N15	0.4678XX	0.6539XX	-0.0177
14	A1146N16	0.7501XX	0.3173##	0.1215
15	A1148N17	0.6202XX	-0.2249	0.0840
	% explained variance	28	15	13

Note. Factor matrix with ## indicating a loading at a significance level of $p < .05$, or values > 0.28 and XX at a significance level of $p < .01$ or values of > .37 irrespective of the confounding nature of the factor.

The three-factor solution explained 55% of the cumulative variance (see Table 22), whereas the last five unrotated factors explained 29% of the variance. Next, a correlation between the three factors was determined assuming a less significant relationship existed if the value was less than 0.5 between the factors. The correlation between Factors 1 and 2 was 0.4112 (see Table 23), which was less than 0.5, indicating a less significant relationship between the two factors. The correlation between Factor 2 and 3 was also significantly less at 0.1025 (see Table 23), and between Factors 1 and 3 was 0.2226 (see Table 23). This implied that participants in this subset of nonusers did not share the same perspectives among the three factors. The value of a perfect 1.0 in the diagonal statistic indicated within-factor correlations.

Table 23

Correlations Between Factor Scores for the Nonuser Group

	Factor		
Factor	1	2	3
1	1.0000	0.4114	0.2226
2	0.4114	1.0000	0.1025
3	0.2226	0.1025	1.0000

Table 24

Comprehensive Reliability Coefficient for the Nonuser Group

	Factor		
Factor characteristic	1	2	3
No. of defining variables	8	3	2
Average relative coefficient	0.800	0.800	0.800
Comprehensive reliability	0.970	0.923	0.889
SE of factor Z-scores	0.174	0.277	0.333

The composite reliability for this subset of respondents when compared to the average reliability coefficient was found to be above 0.8000 (McKeown & Thomas, 1988). A strong reliability coefficient of 97%, 92%, and 89% for Factors 1, 2, and 3, respectively, is illustrated in Table 24. Table 25, calculated by PQMethod 2.20 software (Schmolck, 2011), tabulated the values of standard errors for different factors and indicated significant differences between normalized factor scores making a reference to additional reliability. The diagonal entries in Table 25 are standard error within factors.

Table 25

Standard Errors for Differences in Factor Z-Scores for the Nonuser Group

	Factor		
Factor	1	2	3
1	0.246	0.327	0.376
2	0.327	0.392	0.434
3	0.376	0.434	0.471

Note. Diagonal entries are *SE* within factors.

The factors were characterized based on the Z-Scores for each statement. The statements with Z-Scores higher than 1 and less than -1 characterize the factor. The defining variables of Q-sorts used a confidence level of 99% or $p < 0.01$. Table 26 lists the factor scores and corresponding ranks for nonusers.

Table 26

Factor Scores With Corresponding Ranks for the Nonuser Group

	Factor					
	1		2		3	
No.	Factor score	Rank	Factor score	Rank	Factor score	Rank
1	1.10*	11	-1.11**	42	1.79*	2
2	0.27	20	1.29*	3	0.24	22
3	-0.69	37	0.81	12	-1.31**	47
4	1.14*	10	0.11	27	-1.00	42
5	0.75	12	0.49	19	0.80	11
6	0.63	17	-1.14**	43	-0.52	36
7	0.64	15	0.87	9	0.88	9
8	1.52*	3	0.96	7	2.19*	1
9	-0.51	35	-1.21**	44	-0.64	37
10	-0.98	41	-1.03**	40	-1.16**	44
11	-1.12**	43	-0.24	31	-0.28	31
12	-2.08**	50	-1.23**	45	-0.92	41
13	1.23*	7	0.11	27	-2.19**	50
14	-0.46	31	0.53	16	0.56	16
15	-0.05	27	-0.71	37	-1.99**	49
16	0.08	25	-0.20	30	-1.31**	47
17	0.63	16	0.29	23	0.68	13
18	-0.28	30	1.21*	4	-0.32	32
19	-0.47	32	0.58	15	-0.76	38
20	1.19*	8	1.14*	5	0.20	24
21	-1.15**	44	-1.09**	41	-0.48	35
22	-0.87	39	-0.76	38	-0.40	33
23	-1.85**	49	-0.18	29	-0.92	41
24	-1.03**	42	2.08*	2	0.36	19
25	-0.12	28	-0.38	33	0.00	27
26	-0.18	29	-0.69	36	0.20	24
27	-0.47	33	0.87	10	-1.16**	44
28	0.13	24	0.94	8	1.31*	5
29	1.17*	9	-1.27**	46	1.23*	7
30	1.33*	6	0.4	22	-0.08	28
31	1.44*	5	2.34*	1	1.31*	5

	Factor					
	1		2		3	
No.	Factor score	Rank	Factor score	Rank	Factor score	Rank
32	-1.73**	48	-1.32**	47	0.28	21
33	-0.62	36	-0.92	39	0.56	16
34	1.53*	2	0.47	20	0.40	18
35	1.49*	4	-0.33	32	-1.27**	45
36	-1.29**	45	-0.16	28	-0.24	29
37	1.75*	1	0.78	13	0.56	17
38	0.68	14	0.43	21	-0.48	35
39	0.69	13	0.69	14	0.28	21
40	-0.04	26	-0.53	35	0.72	12
41	-0.49	34	-1.85**	48	1.75*	3
42	-1.41**	47	-1.85**	49	-0.28	30
43	-1.36**	46	-2.14**	50	1.04*	8
44	-0.89	40	0.20	25	1.23*	7
45	0.43	19	0.52	18	0.64	14
46	0.24	21	1.00*	6	0.16	25
47	-0.78	38	0.53	17	-0.84	39
48	0.15	23	-0.42	34	-1.79**	48
49	0.23	22	0.27	24	0.84	10
50	0.45	18	0.83	11	0.12	26

Note. Z-scores with one asterisk (*) indicate greater Q sort agreement and Z-scores with two asterisks (**) indicate greater Q-sort disagreement with statements relative to each factor. Complete statements are in Appendix B.

The factor scores grouped physicians into the following perspectives: (a) a concern for financial, time, technology, organizational, and change related to autonomy redistribution; (b) a concern for proficiency with technical skills, insensitivity to financial elements, and organizationally supportive; and (c) insensitive to change in autonomy redistribution, propensity to learn and try technical skills, concern for system issues, and insensitivity to time constraints. The factor scores and difference scores were used to complete the interpretation and description of the factors for the subset of nonusers of the EHR system.

Factor 1: Nonuser of an EHR System

Factor 1 explained the largest variance of 28% as reflected through the opinions and perspectives of nonusers of the EHR system who were expected to adopt the system in coming 24 months. Factor 1 related to the attributes of finance, technology, time, organization, and autonomy redistribution. These five barriers presented as concerns for the Factor 1 physicians. There were 10 participants (see Table 22) who loaded on this factor at a significance level of 99% for values greater than 0.37 ($p < 0.01$), Equation 3. All 10 participants loaded with a positive association for the factor.

There were 18 distinguishing statements associated with Factor 1 at a confidence level of 95% ($p < 0.05$). Twelve of the 18 distinguishing statements were significant at the 99% confidence level ($p < 0.01$). Of these 12 distinguishing statements, two statements each ranked at +5, +4, and +3 levels of ratings (see Table 27). Two out of the six positively ranked distinguishing statements related to complexity in selection and maintenance of the technology system. Distinguishing statements with a rating of +5 for Factor1 were Statements 34 and 37 (see Table 27). The two statements suggested an agreement with the viewpoint that physicians themselves did not have the expertise to deal with the technology directly nor do they have an experienced staff to make decisions about the technology.

Similarly, of the 12 distinguishing statements, one statement rated at -4 and one statement rated at +4 related to Factor 1's timing or tempo concerns (see Table 27). The distinguishing Statement 36 with a -4 score focused on the ease of use of EHR technology for the process of preparing and submitting a patient record (see Table 27). The disagreement with the statement suggested this process was cumbersome. Physicians stated reasons like lack of experience with data entry, poor typing skills, use of multiple Internet portals, and multiple layers of check boxes and windows impeded the process, thus signifying their time-related doubtfulness to EHR implementation (see comments in Table 28). Presenting with the same sentiment, distinguishing Statement 35 rated with +4, “Using the system requires a lot of extra effort in my practice . . . more employees to complete the task,” reflected the sensitivity to the time and tempo barrier. A high negative Z-Score with Statement 23, “There is a positive impact on the quality of communication with patients in the same amount of time when compared to paper charts,” further confirmed the importance of the time attribute to Factor1 respondents (see Appendix M). The negative ranking of Statement 36, “The process of preparing and submitting patient evaluations through the system is easy for my office to handle,” was evident by participants’ comments as listed in Table 28.

Time factor directly or indirectly affected the productivity of the physicians. The impact of their productivity in terms of billable hours has financial consequences. The negative financial impact of EHR system adoption was evident from the high disagree-with Z-Scores of Statements 29 and 32 (see Appendix M). Physicians believed that expected security and confidentiality of information would require an additional system, labor, and financial expense as indicated in Statement 30 with a rating of +4 (see Tables 27 and 29).

Table 27

All Distinguishing Statements for Factor for the Nonuser Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
37	Capacity to select, install, and contract for an EHR is a concern.	5	1.75*
34	Physicians time to deal with the technology directly without the needed expertise.	5	1.53*
35	An EHR system requires extra time, thus needs more employees for the same amount of work.	4	1.49*
30	Confidentiality and security are costly to install and maintain.	4	1.33*
13	EHR leads to excessive use of guidelines threatening professional autonomy.	3	1.23*
4	Loss of professional autonomy adds resistance to adoption of EHR.	3	1.14*
6	Uncertainty about return on investment is a major barrier.	1	0.63*
28	Leadership, culture of innovation and change, and open infrastructure are helpful in EHR adoption.	0	0.13
15	Interfacing with hospitals is an advantage of EHR for our medical office.	0	-0.05
14	A standalone EHR system has issues of interconnectivity among medical offices for data integration.	-1	-0.46*
41	It is easy for me to become skillful in the use of EHR technology.	-1	-0.49*
44	I like to experiment with new information technologies.	-3	-0.89*
24	Information from physicians from EHR adopters is helpful to other physicians.	-3	-1.03*
11	Universal EHR implementation would enhance healthcare quality.	-3	-1.12
36	It is easy for staff to prepare and submit patient evaluations with EHR.	-4	-1.29*
43	Learning to operate the system was (will be) easy for me.	-4	-1.36
23	Time and quality of face-to-face communication with patients is the same as without computer use.	-5	-1.85
12	Using EMR enables me to complete patient encounters more quickly.	-5	-2.08

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Table 28

Participant Comments for Factor 1 for the Nonuser Group

No.	Statement (abbreviated)	Comment
32	Using the EHR system in my practice has (will) increase my productivity.	It has decreased the number of patients I see every day (Participant: A1120) All physicians I know tell me that the computer slows them down, and interferes with the doctor - patient relationship. I see this when taking my father into the doctor's office: the nurse and doctor pay attention to the key board, not my Dad...(Participant: A1140)
35	Using the system requires a lot of extra effort in my practice. I needed more employees than before to complete the same types of clinical tasks.	Very time consuming. in order to maintain efficiency requires more staff, i.e. scribes (Participant: A1146)
4	Fear of loss of professional autonomy adds resistance to adoption from practice physicians.	Patient confidential records are not the property of insurance carriers, the government or the physicians - they belong to the patient only. If and when a payer or government agent seeks to review practice patterns, all identification of patients' names MUST be de-identified. (Participant: A1140)
29	Loss of long-term productivity is a major concern during the transition.	While learning how to use the EHR, it may slow down productivity and lead to pt complaints, loss of revenue. (Participant: A1134)

Note. EHR = electronic health record.

Table 29

Top Sort Ranking of Distinguishing Statements for Factor 1 for the Nonuser Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
37	Capacity to select, install, and contract for an EHR is a concern.	5	1.75*
34	Physicians time to deal with the technology directly without the needed expertise.	5	1.53*
35	An EHR system requires extra time, thus needs more employees for the same amount of work.	4	1.49*
30	Confidentiality and security are costly to install and maintain.	4	1.33*
13	EHR leads to excessive use of guidelines threatening professional autonomy.	3	1.23*
4	Loss of professional autonomy adds resistance to adoption of EHR.	3	1.14*
44	I like to experiment with new information technologies.	-3	-0.89*
24	Information from physicians from EHR adopters is helpful to other physicians.	-3	-1.03*
11	Universal EHR implementation would enhance healthcare quality.	-3	-1.12
36	It is easy for staff to prepare and submit patient evaluations with EHR.	-4	-1.29*
43	Learning to operate the system was (will be) easy for me.	-4	-1.36
23	Time and quality of face-to-face communication with patients is the same as without computer use.	-5	-1.85
12	Using EMR enables me to complete patient encounters more quickly.	-5	-2.08

Note. Q-SV = Q-sort value; Z-SCR = Z-score EHR = electronic health record; EMR = electronic medical record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Distinguishing Statements 13 and 4 (see Table 29) had a rating of +3, reflecting that the Factor 1 physicians believed an EHR system would result in more scrutiny from third parties with their autonomy being at stake. The organizational factors had a mixed response in attitudes of Factor 1 respondents. The personal or organizational culture that advocated experimenting with new technologies was negatively received by this group of respondents.

Factor 1 did not show neutrality toward any one attribute. Statements related with finance, time, technology, and organization received neutral ratings. The nonspecificity to any one attribute for neutrality by the nonuser group of participants could be because of their reservation to overcome multiple barriers. Table 27 lists all the distinguishing statements for Factor 1; 12 were significant at $p < 0.01$ and are denoted with an asterisk (*).

Factor 2: Nonuser of an EHR System

Factor 2 explained 15% of the total variance for the nonusers of the EHR system in smaller medical practices. The attributes reflected in Factor 2 respondents' attitudes were a positive propensity for organizational factors, insensitivity to financial elements, and negative sensitivity for ongoing technical proficiencies. Factor 2 had seven participants loading at a significance level of 95% ($p < 0.05$, Equation 2) at values greater than 0.28, and five of the seven participants loaded at a significance level of 99% ($p < 0.01$, Equation 3) for values greater than 0.37 (see Table 22). All participants had a positive association with the factor. There were 17 distinguishing statements for Factor 2 at a significance level of 95% ($p < 0.05$). Ten out of the 17 statements had a significance level of 99% ($p < 0.01$). Of those, one each ranked positive at +5, +4 and +3 at a significance level of 99%. Statement 18, "The most common reason for failure of implementation is that the implementation process is treated as a technological problem; human and organizational issues are not fully addressed," rated positively with +4. Statement 28 ,"Organizational factors such as a culture of innovation and change, leadership, infrastructure support and open communication play a critical role in how fast the EHR technology will be adopted," with a high agree-with positive Z-Score supported the same viewpoint (see Appendix N). The belief in culture or trait of innovation in the domain of information technology was represented in Statement 44, “I like to experiment with new information technologies,” which received a rating of 0 (see Table 30).

Statement 41, “It is easy for me to become skillful in EHR technology,” and Statement 43, “Learning to operate the system was (will be) easy for me,” presented with a high disagree-with negative Z-Score value for respondents of Factor 2 (see Appendix N), thus suggesting a negative sensitivity to the technology attribute. Although the operational attributes of the technology were negatively associated, a +5 and +3 rating for the distinguishing Statements 24 and 27 provided the perspectives that this group of responders would rely on peer recommendations and incentives of CMS to adopt the EHR technology. Therefore, Statements 24 and 27 referring to external triggers motivating adoption of an EHR system revealed as a positive promoter according to their viewpoint.

Factor 2 respondents related to the financial barrier with insensitivity. A rating of -3 and a high negative Z-Score for distinguishing Statement 1 (see Appendix N), “The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier,” and a -4 rating for Statement 29, “Loss of long term productivity is a concern during transition,” emphasized that Factor 2 respondents did not believe that the financial impact was damaging in the long term with EHR implementation. Contrary to long-term productivity effects, responders believed there was a negative financial impact due to productivity changes in the short term as illustrated with a high positive Z-Score for Statement 31.

Table 30

All Distinguishing Statements for Factor 2 for the Nonuser Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
31	Loss of short-term productivity is a major concern.	5	2.34
24	Information from physicians from EHR adopters is helpful to other physicians.	5	2.08*
2	Small operating margins demand efficient work routines in practice.	5	1.29
18	Human and organizational issues are reasons for failure of EHR implementation.	4	1.21*
27	The CMS pay-for-performance demonstration has prompted practices positively.	3	0.87*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	2	0.81*
19	A physician's own practice group influenced the EHR adoption.	2	0.58*
47	EHR systems will help assistants take over some medical procedures.	1	0.53*
44	I like to experiment with new information technologies.	0	0.20
13	EHR leads to excessive use of guidelines threatening professional autonomy.	0	0.11*
4	Loss of professional autonomy adds resistance to adoption of EHR.	0	0.11
35	An EHR system requires extra time, thus needs more employees for the same amount of work.	-1	-0.33
15	Interfacing with hospitals is an advantage of EHR for our medical office.	-2	-0.71
1	The amount of capital requirement and availability is an adoption barrier.	-3	-1.11*
29	Loss of long-term productivity is a major concern during the transition.	-4	-1.27*
41	It is easy for me to become skillful in the use of EHR technology.	-5	-1.85*
43	Learning to operate the system was (will be) easy for me.	-5	-2.14

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Factor 2 showed neutrality toward autonomy redistribution. A rating of 0 for Statements 13, "EHR software leads to excessive use of guidelines, therefore, it is threatening to my professional autonomy," and Statement 4, "Fear of loss of professional autonomy adds resistance to adoption from practice physicians," described neutrality to issues of change in autonomy distribution.

Table 31 lists the most significant statements of Factor 2. Physicians who are organizationally positioned are concerned for ongoing technical proficiencies and show insensitivity to financial investment. The loadings suggested that physicians comprising this factor had concerns about learning and operating the EHR technology but perceived that productivity losses were more short term rather long term.

Table 31

Top Sort Ranking of Distinguishing Statements for Factor 2 for the Nonuser Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
31	Loss of short-term productivity is a major concern.	5	2.34
24	Information from physicians from EHR adopters is helpful to other physicians.	5	2.08*
2	Small operating margins demand efficient work routines in practice.	5	1.29
18	Human and organizational issues are reasons for failure of EHR implementation.	4	1.21*
27	The CMS pay-for-performance demonstration has prompted practices positively.	3	0.87*
1	The amount of capital requirement and availability is an adoption barrier.	-3	-1.11*
29	Loss of long-term productivity is a major concern during the transition.	-4	-1.27*
41	It is easy for me to become skillful in the use of EHR technology.	-5	-1.85*
43	Learning to operate the system was (will be) easy for me.	-5	-2.14

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Thus, the nonuser independent physicians had concerns about learning the operating skills associated with the EHR system and were supportive of organizational structure and support factors for adoption and acceptance of systems. Furthermore, these respondents believed that long-term productivity was not a concern although short-term productivity was affected. The respondent comments are listed in Table 32.

Table 32

Participant Comments for Factor 2 for the Nonuser Group

No.	Statement (abbreviated)	Comment
1	The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier.	Reimbursement is already low and we don't have money to devote to something which will just make us less productive. (Participant: A1124) It is not affordable for a small practice to acquire and maintain an EHR system comparable to the ones used in hospital systems that are very expensive. (Participant: A1123)
31	Loss of short-term productivity is a major concern during the transition.	trying to learn the system, trying to teach the system to office staff when we are tech handicap (Participant: A1116) There is a steep learning curve, (Participant: A1128) Introduction into practice is cumbersome and will definitely reduce productivity(Participant: A1146)
41	It is easy for me to become skillful in the use of EHR technology.	Poor computer skills. (Participant: A1145)
43	Learning to operate the system was (will be) easy for me.	Poor computer skills. (Participant: A1145) I enjoy using new tech and learning how things work, my partner is computer illiterate. (Participant: A1134)

Note. EHR = electronic health record.

Factor 3: Nonuser of an EHR System

Sensitivity toward financial elements, unconcern for time and autonomy redistribution, and a mixed reaction to ongoing technical proficiencies emphasized Factor 3 perspectives. This perspective explained 13% of the total variability. Seven participants loaded on this factor at a level of 95% significance with a value greater than 0.28 ($p < 0.05$) as per Equation 2, and three out of seven loadings on this factor were at a significance level of 99% with values greater than 0.37 ($p < 0.01$) as per Equation 3. Factor 3 had 16 distinguishing statements associated with it at a confidence level of 95% ($p < 0.05$). Nine out of 16 statements were associated with this factor at a 99% ($p < 0.01$) confidence level. Of those nine statements, two statements, 41 and 43, had an agree-with rating of +5 and +3, respectively. Both statements suggested that physicians positively believed in their capabilities about learning the skills need to use the technology for operational tasks (see Table 33). The Factor 3 group contrarily associated with overall technical system-related characteristics. The communication interface of the technology was a concern. Independent physicians anticipated trouble interfacing with expensive proprietary hospital systems for the purpose of exchanging information as stated in Statement 15 (see Appendix O).

A high disagreement demonstrated with a negative or disagree-with Z-Score and with a negative rating of -5 for Statement 48, “Using the EHR may decrease my professional discretion over patient care decisions,” and Statement 13, “EHR software leads to excessive use of guidelines, therefore, it is threatening to my professional autonomy.” Redistribution of autonomy was not a concern with EHR technology adoption with Factor 3 respondents (see Table 33). The financial attribute showed sensitivity to the high cost of the technology system and with the loss of long-term productivity. Statement 29, “Loss of long-term productivity is a major concern during the transition,” received a high agree-with Z-Score along with Statement 1 (see Appendix O).

Table 33

Distinguishing Statements for Factor 3 for the Nonuser Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
41	It is easy for me to become skillful in the use of EHR technology.	5	1.75*
44	I like to experiment with new information technologies.	3	1.23
43	Learning to operate the system was (will be) easy for me.	3	1.04*
40	A team approach serves for workflow effectiveness with EHR technology.	2	0.72
33	Analysis of needs and preferences leads to timely conversion to EHR data.	2	0.56*
24	Information from physicians from EHR adopters is helpful to other physicians.	1	0.36*
32	Using the EHR system will (has) increase(d) my productivity.	1	0.28*
20	EHR implementation with a project team adds cost in the adoption process.	0	0.20
42	I can use the system easily while I perform a medical evaluation procedure.	-1	-0.28*
38	CCHIT EHR vendor's longevity in market is a concern.	-2	-0.48
4	Loss of professional autonomy adds resistance to adoption of EHR.	-3	-1.00
35	An EHR system requires extra time, thus needs more employees for the same amount of work.	-4	-1.27
16	My practice is aware and supportive of techno-phobic employee needs.	-4	-1.31
48	EHR may decrease professional discretion over patient-care decisions.	-5	-1.79*
15	Interfacing with hospitals is an advantage of EHR for our medical office.	-5	-1.99*
13	EHR leads to excessive use of guidelines threatening professional autonomy.	-5	-2.19*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; Certification Commission for Healthcare Information Technology. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Factor 3 respondents had a high negative Z-Score for time or tempo. These respondents disagreed with the need to add more employees and did not perceive a greater demand on time for completion of tasks. The time or tempo attribute was also stated with Statement 8 though in contradiction with the previous statement. Statement 8 presented with a high agreed-with Z-Score. Statement 8 stated that there is a limit on how much time physicians could spend to become familiar with the technology (see Appendix P).

The most positively significant distinguishing statements at the 99% confidence level are listed in Table 34. The Factor 3 physicians were not concerned with learning the technology because of their personal traits that encouraged them to become technologically innovative. Similarly, the time factor was not a concern in completion of records needing extra number of employees, but it was a concern in relation to physicians' time. Both technology and the time attribute had mixed associativity (see Appendix O).

Table 34

Top Sort Ranking of Distinguishing Statements for Factor 3 for the Nonuser Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
41	It is easy for me to become skillful in the use of EHR	5	1.75*
43	Learning to operate the system was (will be) easy for me.	3	1.04*
48	Using the EHR may decrease my professional discretion	-5	-1.79*
15	The ability to interface with hospitals is the biggest	-5	-1.99*
13	EHR software leads to excessive use of guidelines, therefore	-5	-2.19*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

The high positive Z-Scores for Statements 41 and 43 (see Appendix O) suggested that attributes such as specialized skills were easy for these respondents. Although the time attribute had mixed representation, financial sensitivity to cost was included in factor3 configuration. The Factor 3 respondents were negatively associated or not concerned with autonomy redistribution. The comments relating to such observations are provided in Table 35.

Table 35

Participant Comments for Factor 3 for the Nonuser Group

No.	Statement (abbreviated)	Comment
41	It is easy for me to become skillful in the use of EHR technology.	I have no time to experiment with the system and nobody is available to help me. (Participant: A1122)
43	Learning to operate the system was (will be) easy for me.	I enjoy using new tech and learning how things work, my partner is computer illiterate. (Participant: A1134)
		I have written software and statistical studies, so I am an early adopter of most technologies. (Participant: A1117)
8	Physicians find lack of time to acquire knowledge about the system a barrier to adoption	In a busy practice the time to relearn a new way of doing things can be prohibitive.(Participant: A1123)
		Some of us do not have the background or training to adapt quickly. (Participant: A1128)
29	Loss of long-term productivity is a major concern during transition	While learning how to use the EHR, it may slow down productivity and lead to patient complaints, loss of revenue

Note. EHR = electronic health record.

Differences Between Factors 1 and 2 for Nonusers

Statements 29 and 1 showed significant difference scores between Factors 1 and 2 (see Appendixes P and Q). On comparison of the two factors, the Factor 1 group was challenged for the financial attribute, whereas the Factor 2 group was not concerned with the capital investment and losses due to reduced long-term productivity. The Factor 1 group ranked Statements 29 and 1 with a +3 rating, whereas the Factor 2 group rated the two statements at -4 and -3, respectively.

Statement 24, “Information and support from physicians who are already EHR users has been very helpful. It was (is going to be) instrumental in my selection of the system,” was positively received by the Factor 2 respondents and negatively received by Factor 1 respondents (see Appendixes P and Q). Factor 2 respondents were more comfortable with learning and operating the EHR system and were more comfortable receiving information from their peers. Factor 1 respondents being more technically stressed did not correlate well with peer recommendations.

Differences Between Factors 1 and 3: Nonusers

Statements 13 and 4 showed significant difference scores between Factors 1 and 3 (see Appendixes P and R). The belief underscoring the two statements dispensed the fact that physicians believed that digitizing medical records would increase scrutiny from external parties. Factor 1 respondents were apprehensive and had concerns for redistribution of autonomy. Factor 3 respondents were not concerned with redistribution of autonomy. Statement 13, “EHR software leads to excessive use of guidelines, therefore, it is threatening to my professional autonomy,” agreed with Factor 1 with a rating of +3 and a strong disagreement from Factor 3 with a rating of -5. Statement 4, “Fear of loss of professional autonomy adds resistance to adoption from practice physicians,” had an agreement of +3 from Factor 1 and a -3 from Factor 3.

The Statement 35, “Using the system requires a lot of extra effort in my practice. I needed more employees than before to complete the same types of clinical tasks,” had a big difference score. Factor 1 individuals had a higher sensitivity for the extra time it takes to complete the records than Factor 3 individuals. Statement 35 had an agreement of +4 rating for Factor 1 and a rating of -4 for Factor 3. There were score differences for technology attribute. The Factor 1 respondents were negatively associated with learning of skills, whereas Factor 3 individuals ranked Statements 41 and 43 positively. Statement 43, “Learning to operate the system was/will be easy for me,” rated at -3 for Factor 1 and + 4 for Factor 3.

Factors 1 and 3 had score differences for Statement 32, “Using the system in my practice has (will increase) increased my productivity,” associated with the financial attribute. Factor 1 respondents associated negatively with a -5, whereas Factor 3 respondents associated more neutrally with the financial attribute. The organizational attribute represented in Statement 44, “I like to experiment with new information technologies,” rated at -3 with Factor 1 and a + 3 with Factor 3. In conclusion, Factors 1 and 3 had high score differences on statements related to autonomy, learning of technical skills, organization, and time attributes.

Differences Between Factors 2 and 3: Nonusers

Statements 41 and 43 showed significant difference of scores between Factors 2 and 3 (see Appendixes P and S). Statement 41, “It is easy for me to become skillful in the use of EHR technology,” was positively (+5) linked with Factor 3 and negatively (-5) with Factor 2. Statement 43 scored a -5 rating for learning new technical skills with Factor 2 and a score of +3 rating with Factor 3. In contrast, Statement 27 was contradictory for the element of technology between the two factors. Statement 27 related to CMS incentives motivating the independent practices to adopt the technology and its processes.

Statement 1, “The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier,” with a rank score of -3 for Factor 2 suggested that physicians who were challenged with learning a new technology were not concerned with the price ticket. In contrast, Factor 3 physicians who were technically more open to learning the system were concerned with the capital investment. A -3 ranking for Statement 1 by Factor 2 physicians might be indicative of the preference for a simpler interface with no price sensitivity.

Statement 3, “Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians,” ranked closer to neutrality with a +2 for Factor 2 physicians and -4 with Factor 3 physicians. The Factor 2 respondents believed that incentives could motivate physicians to adopt the systems. In contrast, the Factor 3 respondents believed that there should be substantial financial advantages for someone to adopt the EHR system. The difference of the score was substantial for Statement 13 relating to change in autonomy redistribution. The Factor 3 respondents did not associate EHR systems with compromised autonomy.

Consensus Statements: Nonuser Respondents

The consensus statements explained the similarities between all the factors for the nonuser respondents of the study. The consensus statements were commonly rated between any pairs of factors. Table 36 lists the consensus statements between the three factors for the nonusers of the EHR system. The similarly ranked statements from physicians categorized dominantly into attributes such as time, organization, and change. Four of the consensus statements associated with the attribute of change in processes.

Table 36

Consensus Statements for Nonuser Groups

		Factor					
		1		2		3	
No.	Statement	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
5*	Small financial incentives modify EHR adoption behavior.	2	0.75	1	0.49	3	0.8
7*	Data conversion from paper to electronic charts is time-consuming.	2	0.64	3	0.87	3	0.88
9	Estimation of time required to convert to electronic records is a challenge.	-2	-0.51	-3	-1.21	-2	-0.64
10*	All stakeholders promoting EHR are focused on quality with limited resources.	-3	-0.98	-3	-1.03	-3	-1.16
17*	Lack of industry standards for an EHR system results in the use of separate portals to gather data by the staff.	2	0.63	0	0.29	2	0.68
21*	EMR use is easy in patient care and management.	-3	-1.15	-3	-1.09	-2	-0.48
22*	It has been easy to tailor the system to how my practice handles reports.	-2	-0.87	-2	-0.76	-1	-0.4
25*	The way the system is designed is inconsistent with how I like to conduct medical evaluations.	0	-0.12	-1	-0.38	0	0
26	There is a need for a buy-in by staff to make them willing to accept the change.	-1	-0.18	-2	-0.69	0	0.2
39*	EHR technology requires physicians and their assistants to align their clinical work flows with the system through software interface.	2	0.69	2	0.69	1	0.28
45*	Management's response to training is critical for EHR implementation success.	1	0.43	1	0.52	2	0.64
46	I may not have the needed training to change from paper-chart to EHR processes.	1	0.24	4	1	0	0.16
49*	Concerns exist for the standalone EHR system's obsolescence and future data migration.	1	0.23	0	0.27	3	0.84
50*	EHR increases monitoring of decisions, thus is an invasion into my style of practice.	1	0.45	3	0.83	0	0.12

Note. EMR = electronic medical record; EHR = electronic health record. Consensus statements are those that do not distinguish between any pair of factors. All listed statements are nonsignificant at $P > .01$, and those flagged with an * are also nonsignificant at $P > .05$.

Statements 21 and 22 had negative ratings, Statement 25 had a neutral rating, and Statement 39 had a positive rating. The process alignment seemed to be a concern for all factors.

Statement 21, “I find it easy to get EMR to do what I need it to do in my patient care and management,” was disagreed with by all participants among the three factors with negative rankings of -3, -3, and -2 at a significance level of $p < 0.01$. Statement 22, “It has been easy to tailor the system to how my practice handles reports,” was disagreed with by all the factors with ratings of -2,-2, and -1 at a significance level of $p < 0.01$. Statement 39, “I am aware that an EHR technology requires physicians and their assistants to align their clinical work flows with the system; the selected system provided the interface to include the important workflows,” had agreed-with ratings of +2, +2, and +1 at a significance of $p < 0.01$. Process alignment with the EHR technical system is viewed as a barrier by the nonusers of the system. This perception is passed on by other stakeholders within the diffusion process.

Time required for data migration was a concern showed with Statements 7 and 49 at a significance of $p < 0.01$. Statement 7, “Entering data into the computer during conversion of paper charts to electronic charts is cumbersome and time consuming,” and Statement 49, “I have concerns if my standalone EHR system becomes obsolete, how would I import old charts into the new system,” rated positive among all three factors (see Table 36). Statement 9 discussing the accuracy in estimation of projected time required to convert paper charts into electronic charts was disagreed with by all factors at a significance of $p < 0.05$.

Statements 10 and 45 (see Table 36) had consensus with all factors for the nonuser respondents. Statement 10, “I believe that all stakeholders’ interested in promoting EHR use . . . using the limited resources where they are likely to bear the most fruits and all of them have the same goals of quality,” rated with -3 for all factors. Statement 45, “Top management’s response to training for EHR has been critical to the success of EHR implementation,” had close to neutral ratings of +1, +1 and +2 for the three factors. The role of managing agencies, especially external to the practice, was not favorably perceived in physicians’ perspectives although internal management’s response was considered as important and positive. The consensus among the participants dominantly resided with processes, time, and management-related organizational concerns.

Factor Analysis: Users of an EHR System

The determination of the complexion of factors for respondents who are currently using EHR system in small independent practices for up to 5 years was next completed with PQMethod 2.20 software (Schmolck, 2011). The factor analysis for users of an EHR system when compared with the analysis of nonusers provided a better understanding of the differences in perspectives.

In the study, 20 participants had either worked with a basic or comprehensive EHR system for up to 5 years in their independent medical offices. The adopted methodological procedures were the same for data analysis of this subset of participants. A determination of significance at the level of 0.01 or $p < 0.01$ at a value greater than 0.37 as per Equation 3 and at the level of 0.05 or $p < 0.05$ at a value greater than 0.28 as per Equation 2 was made to eliminate the likelihood of having the correlation happen by chance. The 20 participants correlated into a correlational matrix showing how each variant related with the other. The correlational matrix for this subgroup of respondents is presented in Appendix T. Principal component analysis provided the eight unrotated factors for this subset of respondents. The eight unrotated factor matrix (see Appendix U) further used the varimax rotation to extract the final three factors. Table 37 shows the factor loadings for each variant using PQMethod 2.20 (Schmolck, 2011).

A 49% cumulative variance explained the three-factor solution (see Table 37). A determination of existence of a significant relationship between the three extracted factors hinged on whether the value for the significance was greater than 0.5. The correlation between Factors 1 and 2 was 0.2471, between Factors 2 and 3 was 0.1624, and between Factors 1and 3 was 0.4505, thus correlation between the three extracted factors was less than significant (see Table 38). The correlation between different factor combinations was less than the significant value of 0.5, thus implying that participants in the subsets did not share the same perspectives.

The comprehensive reliability for this subset of respondents when compared to the average reliability coefficient was above 0.8000 (McKeown & Thomas, 1988). Factor 1 had the strong reliability coefficient of 98.0%. Similarly, Factor 2 had a 94.0% comprehensive reliability, and Factor 3 presented with 92.3% reliability (see Table 39). Additional reliability was computed using standard errors for difference. Table 40 tabulates the values calculated by PQMethod 2.20 software (Schmolck, 2011) of significant differences between normalized factor scores. The diagonal entries in Table 40 are standard error within factors.

Table 37

Factor Matrix With the Defining Sort Loadings for the User Group

No.	QSORT	Loading 1	Loading 2	Loading 3
1	A1111U1	0.3584##	0.5161XX	0.0904
2	A1112U2	0.6636XX	0.3412##	-0.0652
3	A1115U4	0.2423	0.4491XX	0.2287
4	A1117U5	0.5131XX	0.1738	0.3158##
5	A1118U6	0.0213	0.7222XX	0.3157##
6	A1119U7	0.6306XX	0.2236	0.1788
7	A1121U8	0.3805XX	0.4121XX	0.1507
8	A1122U9	0.5994XX	0.0085	0.1366
9	A1127U11	0.5958XX	0.1894	0.2986##
10	A1129U12	0.1671	0.1735	0.5994XX
11	A1135U14	0.5346XX	0.3329##	-0.3275##
12	A1137U16	0.2149	-0.0857	0.8032XX
13	A1138U17	-0.0234	0.7688XX	-0.1734
14	A1139U18	0.6974XX	-0.1928	0.1423
15	A1142U19	0.6816XX	-0.1545	0.3550##
16	A1143U20	0.1797	0.1774	0.7373XX
17	A1144U21	-0.4935XX	0.0018	0.1922
18	A1147U22	0.6783XX	0.0706	0.2360
19	A1150U23	0.5168XX	0.0079	0.3476##
20	A1151U24	0.7206XX	0.0410	0.2402
	% explained variance	25	11	13

Note. Factor matrix with ## indicating a loading at a significance level of $p < .05$, or values > 0.28 and XX at a significance level of $p < .01$ or values of > .37 irrespective of the confounding nature of the factor.

The factor scores and rankings for the statements suggested the attitudes held by physicians who are currently using the system. The three factors revealed for the users subset of respondents were (a) sensitivity with a concern for change in processes and work practices and time as a barrier; (b) sensitivity with a concern for time, concern for lack of organizational support from management, and a mixed sensitivity for financial elements; and (c) belief in factors of organizational culture and support, concern for technology, and time. These findings may help physicians and project managers to plan and prepare the ongoing use of the system for satisfying experiences (see Table 41).

Table 38

Correlations Between Factor Scores for the User Group

	Factor		
Factor	1	2	3
1	1.0000	0.2471	0.4505
2	0.2471	1.0000	0.1624
3	0.4505	0.1624	1.0000

Table 39

Comprehensive Reliability Coefficient for the User Group

	Factor		
Factor characteristic	1	2	3
No. of defining variables	12	4	3
Average relative coefficient	0.800	0.800	0.800
Comprehensive reliability	0.980	0.941	0.923
SE of factor Z-scores	0.143	0.243	0.277

The complete interpretation of factors used factor scores and difference scores for the user of an EHR system. The statements with Z-Scores higher than 1 and less than -1 were used to characterize the factor along with the defining variables of Q-sorts at a confidence level of 99% or $p < 0.01$ (van Exel & de Graaf, 2005).

Table 40

Standard Errors for Differences in Factor Z-Scores for the User Group

	Factor		
Factor	1	2	3
1	0.202	0.281	0.312
2	0.281	0.343	0.368
3	0.312	0.368	0.392

Table 41

Factor Scores with Corresponding Ranks for the User Group

	Factor					
	1		2		3	
No.	Factor score	Rank	Factor score	Rank	Factor score	Rank
1	0.53	19	0.25	21	-0.47	32
2	0.08	29	1.55*	5	0.59	17
3	-0.78	37	1.93*	2	0.81	14
4	0.17	25	0.18	24	-0.61	34
5	-0.66	35	-0.47	33	0.28	22
6	0.27	22	0.51	12	1.18*	5
7	1.15*	6	2.14*	1	1.12*	6
8	1.33*	3	0.37	17	-0.68	35
9	-1.41**	45	0.74	10	1.03*	10
10	-1.00**	39	0.39	16	-1.25**	45
11	-1.4**	44	0.47	13	-0.19	30
12	-1.89**	50	-1.88**	50	-2.11**	50
13	0.08	28	0.45	14	-0.05	33
14	0.65	17	1.6*	4	-0.24	31
15	-1.25**	42	-1.50**	45	-0.01	26
16	-0.39	33	0.40	15	0.82	13
17	0.77	14	1.39*	6	0.77	16
18	0.17	26	-0.68	37	0.17	23
19	0.39	21	0.25	20	1.08*	9
20	0.84	11	0.05	27	0.97	11
21	-1.76**	49	-0.74	39	-0.91	40

	Factor					
	1		2		3	
No.	Factor score	Rank	Factor score	Rank	Factor score	Rank
22	-1.65**	48	-0.56	35	-1.22**	44
23	-1.37**	43	-0.49	34	-1.53**	47
24	-0.04	31	-0.97	41	1.65**	2
25	1.13**	7	0.33	19	-0.71	36
26	1.03**	9	0.13	26	0.47	19
27	-0.82	38	-0.11	29	0.11	25
28	1.16*	5	1.37*	7	0.79	15
29	1.21*	4	-1.02**	42	1.10*	7
30	0.83	12	0.22	23	0.55	18
31	1.71*	1	-1.55**	48	1.41*	3
32	-1.51**	46	-0.86	40	-1.56**	48
33	0.17	27	1.09*	9	0.36	21
34	0.99	10	-0.07	28	-1.19**	42
35	1.70*	2	0.14	25	1.38*	4
36	-1.02**	40	-0.29	32	0.12	24
37	0.65	16	-0.61	36	-1.21**	43
38	0.67	15	0.34	18	-0.73	38
39	0.07	30	0.62	11	1.08*	9
40	0.77	13	-0.15	31	1.99*	1
41	-0.66	36	-0.12	30	-1.05**	41
42	-1.55**	47	-1.7**	49	-0.73	38
43	-0.55	34	-1.55**	47	-0.90	39
44	0.24	24	-1.11**	43	-0.17	29
45	0.26	23	-1.26**	44	0.41	20
46	-0.20	32	1.10*	8	-1.61**	49
47	-1.24**	41	0.25	22	-0.10	28
48	0.44	20	-0.72	38	-0.01	27
49	0.59	18	1.67*	3	-1.44**	46
50	1.08*	8	-1.54**	46	0.90	12

Note. Z-scores with one asterisk (*) indicate greater Q sort agreement and Z-scores with two asterisks (**) indicate greater Q-sort disagreement with statements relative to each factor.

Factor 1: User of an EHR System

The largest variance of 25% was associated with perspectives held by Factor 1. Factor 1 dominantly associated with barriers of time and process change. Factor 1 had neutrality for the organizational attribute. There were 14 participants (see Table 37) who loaded on this factor at a level of 95% significance for values greater than 0.28 ($p < 0.05$) as per Equation 2. Thirteen out of 14 participants loaded at a 99% significance for values greater than 0.37 ($p < 0.01$) as per Equation 3. One out of the 14 had a negative association with this factor.

There were 17 distinguishing statements associated with Factor 1 at a confidence level of 99% at $p <0.01$. The concern of considerable impact on process change and work practice linked with adoption of EHR technology revealed within the attitudes of the user physicians. Statements 21 and 11 had ratings of -5 and -3, respectively (see Table 42). The statements “I find it easy to get EMR to do what I need it to do in my patient care and management” and “The goals of EHR implementation are to enhance healthcare quality and patient safety through reduced work steps and errors. I feel that EHR implementation will reduce work steps and errors” were negatively rated with Factor 1 respondents. Statement 25, “The way the system is designed is (maybe) inconsistent with how I like to conduct medical evaluations,” supported the opinion that users of EHR were dissatisfied with how their system integrated with the medical work practices and routines. The process-related change was illustrated with high Z-Scores too (see Appendix V).

Table 42

All Distinguishing Statements for Factor 1 for the User Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
8	Physicians face lack of time to acquire knowledge of EHR system.	5	1.33*
25	The way the system is designed is inconsistent with how I like to conduct medical evaluations.	3	1.13*
34	Physicians time to deal with the technology directly without the needed expertise.	3	0.99*
40	A team approach serves for workflow effectiveness with EHR technology.	2	0.77*
37	Capacity to select, install, and contract for an EHR is a concern.	2	0.65*
14	A standalone EHR system has issues of interconnectivity among medical offices for data integration.	1	0.65*
49	Concerns exist for the standalone EHR system's obsolescence and future data migration.	1	0.59*
24	Information from physicians from EHR adopters is helpful to other physicians.	-1	-0.04*
46	I may not have the needed training to change from paper-chart to EHR processes.	-1	-0.20*
16	My practice is aware and supportive of techno-phobic employee needs.	-1	-0.39*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	-2	-0.78*
27	The CMS pay-for-performance demonstration has prompted practices positively.	-2	-0.82
36	It is easy for staff to prepare and submit patient evaluations with EHR.	-3	-1.02*
47	EHR systems will help assistants take over some medical procedures.	-3	-1.24*
11	Universal EHR implementation would enhance healthcare quality.	-3	-1.40*
9	Estimation of time required to convert to electronic records is a challenge.	-4	-1.41*
21	EMR use is easy in patient care and management.	-5	-1.76*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CMS = Center for Medicare and Medicaid Services. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

The sensitivity to the time barrier was illustrated in the opinions of Factor 1 respondents who are EHR system users. Statements 8 and 36 related to time as a constraint for activities such as gaining knowledge about the system and for completion of a medical evaluation of a digitized record. The distinguishing Statement 36 negatively rated at -3 reflected on the time constraint. It discussed the cumbersomeness of the system in preparing and submitting patient evaluations (see Table 42). Both physicians and supporting staff required increased use of resources. Physicians required additional time to complete the digital chart, indicating the perceived usefulness and perceived ease of use might be a concern for a Factor 1 participant. Statement 9, “My office was/is able to estimate in close approximation the projected time required to convert paper charts into electronic charts for the EHR system,” scored a high negative Z-Score, supporting the opinion that time to convert the paper charts had a large overhead, thus was a time-consuming task. As evident from Statement 9, medical practices could not estimate the conversion time with accuracy; it resulted in short-term losses in productivity, as stated with Statement 31. This financial attribute received a high positive Z-Score (see Appendix V).

Neutrality was represented with distinguishing statements that were rated at +1 and -1 (see Table 43). The statements fell within the scope of culture and management-related concerns. The technology element in integrating the information played neutrality too. None of the distinguishing statements rated at a score of 0 for this factor. Supporting comments with the top distinguishing statements are listed in Table 44.

Table 43

Top Distinguishing Statements for Factor 1 for the User Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
8	Physicians face lack of time to acquire knowledge of EHR system.	5	1.33*
25	The way the system is designed is inconsistent with how I like to conduct medical evaluations.	3	1.13*
34	Physicians time to deal with the technology directly without the needed expertise.	3	0.99*
36	It is easy for staff to prepare and submit patient evaluations with EHR.	-3	-1.02*
47	EHR systems will help assistants take over some medical procedures.	-3	-1.24*
11	Universal EHR implementation would enhance healthcare quality.	-3	-1.40*
9	Estimation of time required to convert to electronic records is a challenge.	-4	-1.41*
21	EMR use is easy in patient care and management.	-5	-1.76*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Table 44

Comments for Factor 1 for the User Group

No.	Statement (abbreviated)	Comment
21	I find it easy to get EMR to do what I need it to do in my patient care and management.	The interface is complex to complete the necessary information for patient record. There are too many buttons to use before a complete history is gathered. (Participant: A1112)
9	My office has been (was) able to estimate in close approximation the projected time required to convert paper charts into electronic charts for the EHR system.	My office is swamped with many day to day activities, and it is hard to change into new routine. (Participant: A1112) Grossly under estimated it. (Participant:A1119)
25	The way the system is designed is inconsistent with how I like to conduct medical evaluation.	Epic did not follow the line of questioning that I use and was taught in medical school (Participant: A1151)
8	Physicians find lack of time to acquire knowledge about the system a barrier to adoption	I have a very busy practice, and I am more comfortable with keeping paper charts. (Participant: A1112) I had no help, I had to do the research on my own and I did not feel qualified to make such an important decision. (Participant: A1122) I was busy enough before so adding the burden of learning a new system subtracts from the time available. (Participant: A1137)
11	The goals for EHR implementation are to enhance healthcare quality and patient safety through reduced work steps and errors	Work steps are actually increased initially. (Participant: A1114) Has nothing to do with enhanced healthcare. (Participant: A1139) Implementation should make life easier if the cost is undertaken. (Participant: A1144)

Note. EMR = electronic medical record; EHR = electronic health record.

Factor 2: User of an EHR System

The Factor 2 attitudes explained 11% of the variance of the user subset of respondents. Factor 2 dominantly related to barriers of finance, time, and organization. These physicians had a concern for time constraints and organizational support, whereas they had a mixed response to financial elements. There were seven participants (see Table 36) who loaded on this factor at a level of 95% significance for values greater than 0.28 ($p < 0.05$) as per Equation 2. Four out of seven participants loaded at a 99% significance for values greater than 0.37 ($p < 0.01$) as per Equation 3.

There were 22 distinguishing statements associated with Factor 2 at a confidence level of 95% or $p < 0.05$. Eighteen of the 22 distinguishing statements associated with the factor at a confidence level of 99% or $p < 0.01$. Sensitivity to time as a constraint with EHR acceptance and diffusion was reflected in the perspective of Factor 2 respondents. Statement 7, “Entering data into the computer during conversion of paper charts to electronic charts is cumbersome and time consuming,” and Statement 49, “I have concerns if my standalone EHR system becomes obsolete, how would I import old charts into a new system,” reflected on the time concerns for migration of data to a new system (see Table 45). This concern was founded on converting paper documents into electronic format and converting data from one system to another in case of an obsolescence of the current system. Statement 14 related to time inefficiencies with data integration between systems run by various organizations. The constraint of time associated with EHR technology is faced by physicians in many dimensions, such as an increased time requirement to complete the records, increased time requirement to gather and integrate data among different institutional systems, conversion of data from one format to another, and increased time requirement to align the work routines with the technical system.

The distinguishing statements related to the financial elements had mixed ratings for Factor 2 respondents. Distinguishing Statement 3, "Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians," and distinguishing Statement 2, "A smaller operating margin related to EHR (electronic health record) adoption requires higher efficiency expectancy in all administrative and clinical work routines," rated at +5 and +4 suggested that physicians who were users of the system believed that the system needed to be managed effectively to balance the financial impact (see Table 45). A contraindicating response of this group of physicians for financial attribute was indicated through Statements 29 and 31. Distinguishing Statements 29 and 31 had negative ratings related to loss of short-term and long-term productivity during EHR transition (see Table 45). Furthermore, these two statements showed high disagreement Z-Scores suggesting a good incentive program would help overcome productivity loss concerns (see Appendix W).

Distinguishing Statements 45 and 46 associated Factor 2 physicians with the organizational attribute. Statement 45 illustrated high disagree-with Z-Scores and a rating of -3 (see Appendix W). Both statements represented the viewpoint that training and support from management were not enough (see Table 45). Factor 2 respondents had no specific attribute with neutrality. The list of top distinguishing statements is in Table 46. The comments supporting the viewpoints are listed in Table 47.

Table 45

All Distinguishing Statements for Factor 2 for the User Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
7	Data conversion from paper to electronic charts is time-consuming.	5	2.14*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	5	1.93*
49	Concerns exist for the standalone EHR system’s obsolescence and future data migration.	5	1.67*
14	A standalone EHR system has issues of interconnectivity among medical offices for data integration.	4	1.60*
2	Small operating margins demand efficient work routines in practice.	4	1.55*
46	I may not have the needed training to change from paper-chart to EHR processes.	3	1.10*
33	Analysis of needs and preferences leads to timely conversion to EHR data.	3	1.09
10	All stakeholders promoting EHR are focused on quality with limited resources.	2	0.39*
8	Physicians face lack of time to acquire knowledge of EHR system.	1	0.37*
25	The way the system is designed is inconsistent with how I like to conduct medical evaluations.	1	0.33*
35	An EHR system requires extra time, thus needs more employees for the same amount of work.	0	0.14*
20	EHR implementation with a project team adds cost in the adoption process.	0	0.05
34	Physicians time to deal with the technology directly without the needed expertise.	0	-0.07*
40	A team approach serves for workflow effectiveness with EHR technology.	-1	-0.15*
23	Time and quality of face-to-face communication with patients is the same as without computer use.	-1	-0.49*
18	Human and organizational issues are reasons for failure of EHR implementation.	-2	-0.68
24	Information from physicians from EHR adopters is helpful to other physicians.	-3	-0.97*
29	Loss of long-term productivity is a major concern during the transition.	-3	-1.02*
44	I like to experiment with new information technologies.	-3	-1.11
45	Management’s response to training is critical for EHR implementation success.	-3	-1.26*
50	EHR increases monitoring of decisions, thus is an invasion into my style of practice.	-4	-1.54*
31	Loss of short-term productivity is a major concern.	-5	-1.55*

Note. Q-SV = Q-sort value; Z-SCR = Z-score. Both the factor Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Table 46

Top Distinguishing Statements for Factor 2 for the User Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
7	Data conversion from paper to electronic charts is time-consuming.	5	2.14*
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	5	1.93*
49	Concerns exist for the standalone EHR system's obsolescence and future data migration.	5	1.67*
14	A standalone EHR system has issues of interconnectivity among medical offices for data integration.	4	1.60*
2	Small operating margins demand efficient work routines in practice.	4	1.55*
46	I may not have the needed training to change from paper-chart to EHR processes.	3	1.10*
24	Information from physicians from EHR adopters is helpful to other physicians.	-3	-0.97*
29	Loss of long-term productivity is a major concern during the transition.	-3	-1.02*
44	I like to experiment with new information technologies.	-3	-1.11
45	Management's response to training is critical for EHR implementation success.	-3	-1.26*
50	EHR increases monitoring of decisions, thus is an invasion into my style of practice.	-4	-1.54*
31	Loss of short-term productivity is a major concern.	-5	-1.55*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factor Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Factor 3: Users of an EHR System

The attitudes of Factor 3 physicians explained 13% of the variance. The dominant attributes associated with this factor were organization and time. There were nine participants (see Table 36) who loaded on this factor at a level of 95% significance for values greater than 0.28 ($p < 0.05$) as per Equation 2. Three out of nine participants loaded at 99% significance for values greater than 0.36 ($p < 0.01$) as per Equation 3. One out of the nine had a negative association with this factor.

Table 47

Participant Comments for Factor 2 for the User Group

No.	Statement (abbreviated)	Comment
7	Entering data into the computer during conversion of paper charts to electronic charts is cumbersome and time consuming.	Particularly for established patients there is a lot of data entry. (Participant: A1150) My long term staff is used to the old ways of keeping records. I have a large practice with charts with large amount of data for my practice (Participant: A1112)
14	A standalone EHR is not going to solve the issue of interconnectivity with other physician offices and hospitals resulting in inefficiencies with data integration.	Systems don't communicate with each other(Participants: A1127)
3	Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption.	This will make it more cost effective (Participant: A1138)

Note. EHR = electronic health record.

There were 15 distinguishing statements associated with Factor 3 at a confidence level of 95% or $p < 0.05$; 12 of these associated at a confidence level of 99% or $p < 0.01$. The opinions of physicians showed a positive propensity for organizational support in EHR adoption. The distinguishing Statement 40 had a rating of +5 (see Table 48). Statement 40, “My staff and I understood that a team approach would best serve the workflow effectiveness when using an EHR technology,” illustrated that Factor 3 believed that organizational support and culture are essential for diffusion of the EHR technology. Statement 46, “I may not/did not receive essential guidance or explanation on how to adopt paper-based processes into the EHR environment,” ranked with a -5 ascertained that the experiences with management and other organizational elements contributed positively in their EHR implementation. Both statements were assigned high Z-Scores (see Appendix X).

Table 48

All Distinguishing Statements for Factor 3 for the User Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
40	A team approach serves for workflow effectiveness with EHR technology.	5	1.99*
24	Information from physicians from EHR adopters is helpful to other physicians.	5	1.65*
19	A physician’s own practice group influenced the EHR adoption.	3	1.08
3	Monetary pay-for-performance and discounted software incentives may achieve next big wave of EHR adoption.	2	0.81*
5	Small financial incentives modify EHR adoption behavior.	1	0.28
15	Interfacing with hospitals is an advantage of EHR for our medical office.	0	-0.01*
14	A standalone EHR system has issues of interconnectivity among medical offices for data integration.	-1	-0.24*
4	Loss of professional autonomy adds resistance to adoption of EHR.	-1	-0.61
8	Physicians face lack of time to acquire knowledge of EHR system.	-2	-0.68*
25	The way the system is designed is inconsistent with how I like to conduct medical evaluations.	-2	-0.71*
38	CCHIT EHR vendor’s longevity in market is a concern.	-2	-0.73*
42	I can use the system easily while I perform a medical evaluation procedure.	-2	-0.73*
34	Physicians time to deal with the technology directly without the needed expertise.	-3	-1.19*
49	Concerns exist for the standalone EHR system’s obsolescence and future data migration.	-4	-1.44*
46	I may not have the needed training to change from paper-chart to EHR processes.	-5	-1.61*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record; CCHIT = Certification Commission for Healthcare Information Technology. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

The sensitivity to the time attribute was also represented in the opinions of Factor 3 respondents with Statement 49 at a rating of -4. Statement 49 discussed the time limitations associated with technology obsolescence and migration of records to a new system. Statement 12 was represented with a high negative Z-Score. Statement 12, "Using EMR enables me to complete patient encounter more quickly," associated this factor's individuals with time constraints of adopting the technology (see Appendix X).

Table 49

Top Distinguishing Statements for Factor 3 for the User Group

No.	Statement (abbreviated)	Q-SV	Z-SCR
40	A team approach serves for workflow effectiveness with EHR technology.	5	1.99*
24	Information from physicians from EHR adopters is helpful to other physicians.	5	1.65*
19	A physician's own practice group influenced the EHR adoption.	3	1.08
34	Physicians time to deal with the technology directly without the needed expertise.	-3	-1.19*
49	Concerns exist for the standalone EHR system's obsolescence and future data migration.	-4	-1.44*
46	I may not have the needed training to change from paper-chart to EHR processes.	-5	-1.61*

Note. Q-SV = Q-sort value; Z-SCR = Z-score; EHR = electronic health record. Both the factors Q-SV and Z-SCR are shown at $P < .05$; asterisk (*) indicates significance at $P < .01$.

Factor 3 had no one attribute with neutrality. Distinguishing Statement 15 was rated at a 0. The statement related to technology's lack of compatible interface for connectivity between systems. This group of physicians was not concerned with this limitation. The top distinguishing statements are listed in Table 49. The two attributes that shaped the perspectives of users of EHR technology for Factor 3 were a concern for the time barrier and propensity for attributes of organizational culture and support. The comments related to these attributes are listed in Table 50.

Table 50

Participant Comments for Factor 3 for the User Group

No.	Statement (abbreviated)	Comment
24	Information and support from physicians who are already EHR users have been very helpful. It was (is going to be) instrumental in my selection of the system..	When we selected a system for ophthalmology, we wanted an experienced EHR vendor with many installations we could see in operation. (Participant: A1117)
12	Using EMR enables me to complete patient encounter more quickly.	We are much slower (it takes 2x as long to see patients) (Participant: A1117) Takes much more time to fill in templates during interviews (Participant: A1111) No, It takes me much longer to document the same information. I write faster than I type. (Participant: A1112) It takes more time to complete patient encounter due poor typing skills and additional data requested by most EMR's (Participant: A1115) It is slower and less patient face to face time--may need to get a scribe and increase expenses rather than having patients watch me watch a computer screen. (Participant: A1137) I still cannot see more patients than prior to EMR. The documentation is extensive(Participant: A1150)
49	I have concerns if my standalone EHR system becomes obsolete, how would I import old charts into a new system.	Importing old data can get to be very expensive if my EMR becomes obsolete (Participant: A1135)

Note. EHR = electronic health record.

Differences Between Factors 1 and 2: Users of an EHR System

Factors 1 and 2 showed a significant difference score for Statement 50 (see Appendixes Y and Z). On comparison of the two factors, Factor 1 physicians revealed a concern for the barrier of change, especially changes in autonomy. Autonomy redistribution was a challenge revealed in the attitudes of Factor 1 physicians as opposed to Factor 2. The ranking of +4 and -3 demonstrated the difference between Factor 1 and Factor2 respectively.

Factor 1 and 2 showed a significant difference score for Statement 9 (see Appendixes Y and Z). On comparison of the two factors, Factor 1 physicians revealed a concern for the time barrier. Estimation of time to convert paper charts to electronic format was a negative experience for Factor 1 physicians as opposed to Factor 2. The ranking of -4 and +3 demonstrated the difference between Factor 1 and Factor 2, respectively. The barrier associated with time constraint showed in the viewpoints of both Factor 1 and Factor 2 physicians although experiences regarding estimation of time to convert the records to electronic format varied between these two factors.

Factors 1 and 2 showed a significant difference score for Statement 31 (see Appendixes Y and Z). Although financial barriers did not reveal in the perspectives of Factors 1 and 2 physicians, the users of the EHR system, a significant difference score presented a difference in attitudes regarding financial impact through productivity changes. On comparison of the two factors, the Factor 1 group presented with beliefs that these physicians were concerned with the issues of productivity. Short-term productivity losses may be explained because of the extra steps required to complete the documentation of the medical encounter. Additionally, productivity loss could be a result of time spent on converting the data into an electronic format. Statement 31, “Loss of short-term productivity is a major concern during the transition,” was ranked +5 for Factor 1 and -5 for Factor 2. The finance constraint was further demonstrated as a barrier by Factor 1 with Statement 3, “Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians,” which was disagreed-with by Factor 1 respondents. On the contrary, the Factor 2 respondents agreed that the monetary incentives would motivate EHR adoption. The respective ratings between two factors for Statement 3 were -2 and +5. In sum, significant difference scores revealed attitudes recognizing other barrier elements buried in the extracted factors.

The physician group in Factor 1 believed that the electronic format of records will lead to an increased overseeing by insurance and other governing bodies. Statement 50, “Using EHR may increase monitoring and reviewing of diagnostic and therapeutic decisions by non-providers resulting in greater invasion into my style of providing treatment,” stated such a concern for Factor 1 with a score of +3. Factor 2 physicians did not feel such pressure. Autonomy redistribution was a concern for Factor 1 physicians, which was not the case with Factor 2 physicians. Factor 1 physicians perceived that, with the increased ability to share data among interested parties, the control and watch vulnerability might increase for the physicians; the Factor 2 physicians had an opposite viewpoint. Thus, financial elements and autonomy shift were the attributes that were perceived differently by the two types of factor profiles.

Differences Between Factors 1 and 3: Users of an EHR System

Statements 49 and 9 showed significant difference scores between Factors 1 and 3 (see Appendixes Y and AA). Statement 9, "My office was/is able to estimate in close approximation the projected time required to convert paper charts into electronic charts for the EHR system," showed a negative association with Factor 1, whereas Factor 3 had a positive experience with time estimation for conversion of paper charts to electronic charts. Statement 9 had a rating of -4 with Factor 1 individuals as compared to a rating of +3 with Factor 3 individuals. Factor 3 users of EHR revealed positive propensity for organizational support and culture, which possibly gave them a better ability to manage time constraints. Factor 1 individuals had experiences that associated negatively with process change and the time attribute. The element of obsolescence stated in statement 49 could be explained with similar reasoning. Better organizational support may lead to better management of time constraints.

Statement 34, "Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system," had an agree-with perspective from Factor 1 with a rating of +3. Factor 3 respondents did not show concurrence with a ranking of -3. Even though the technology constraint was true for Factor 3 individuals, they perceived a need to support the technology with better organizational support and culture.

Differences Between Factor 2 and 3: Users of an EHR System

Statements 46 and 40 showed significant difference scores between Factors 2 and 3 (see Appendixes Y and AB). Organizational attributes underlined the significant difference scores between the two factors. Statement 46, "I may not/did not receive essential guidance or explanation on how to adopt paper-based processes into the EHR environment," suggested a lack of training was a concern for Factor 2 physicians with a +3 rating. Factor 3 respondents had more positive experiences with training and management responsiveness unlike Factor 2. Factor 3 physicians responded with a -5 rating for this statement.

Statements 31 and 29 showed significant difference scores between Factors 2 and 3 (see Appendixes Y and AB). The belief underscoring the two statements dispensed the viewpoint that physicians differed in their perspectives on the financial impact of productivity losses. Factor 2 respondents were not concerned with the financial impact caused by productivity losses, whereas Factor 3 respondents agreed with it, and it was a big concern for them. Statement 31 discussed the short-term productivity loss, whereas Statement 29 discussed the long-term productivity loss. Statement 31 had a rating of -5 with Factor 2 respondents and a +5 rating with Factor 3 respondents. Similarly, Statement 29 had a disagree-with rating of -3 with Factor 2 respondents and an agree-with rating of + 3 with Factor 3 respondents.

Statement 49, "I have concerns if my standalone EHR system becomes obsolete, how I would import old charts into a new system," had an agree-with perspective from Factor 2 physicians with a rating of +5. Factor 3 respondents negatively related to the time constraint with a -4 rating. Factors 2 and 3 had significant difference scores for the change in autonomy with Statement 50. Factor 2 with a ranking of -4 showed a concern with autonomy redistribution, whereas Factor 3 with a ranking of +2 did not show the concern. The difference scores between two factors were related to financial, time, organizational support, and change with autonomy.

The significant difference scores reflected that attitudes of Factor 1 and Factor 3 for the users of EHR showed concern for productivity-related financial impact after the purchase of EHR. Factor 2 respondents were insensitive to productivity-related concerns. Factor 1 and 3 perceived a concern for autonomy redistribution unlike Factor 2 respondents. Factor 2 respondents showed concerns for training and organizational support, whereas Factor 1 and 3 respondents did not

Consensus Statements: Users of an EHR System

The consensus statements are the statements that describe the similarities between the factors (van Exel & de Graaf, 2005). These statements are indistinguishable between any pairs of factors. The list of consensus statements for current EHR users in small independent practices is listed in Table 51. The similarly ranked statements from physicians categorized into organizational and time attributes at a level of 99% significance. Six statements out of a total of eight had consensus between all factors at a level of 95% significance.

One of the consensus statements associated positively with all factors represents organizational attribute. Statement 28 stated the role of management with leadership, open communication, and culture of innovation in the early adoption of an EHR system. The statement was agreed on by all participants between the three factors with positive rankings of +5, +3, and +2 at a significance level of $p < 0.01$. The time constraint associated with completion of patient encounter using an EHR system as stated in Statement 30 was negatively rated among all three factors. Statement 30 was rated at -5, -5, and -5 among the three factors at a significance level of $p < 0.01$ (see Table 51).

Table 51

Consensus Statements for the User Group

		Factor					
		1		2		3	
No.	Statement	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
4	Loss of professional autonomy adds resistance to adoption of EHR.	0	0.17	0	0.18	-1	-0.61
12*	Using EMR enables me to complete patient encounters more quickly.	-5	-1.89	-5	-1.88	-5	-2.11
17	Lack of industry standards for an EHR system results in the use of separate portals to gather data by the staff.	2	0.77	4	1.39	2	0.77
19	A physician's own practice group influenced the EHR adoption.	1	0.39	1	0.25	3	1.08
28*	Leadership, culture of innovation and change, and open infrastructure are helpful in EHR adoption.	4	1.16	3	1.37	2	0.79
30	Confidentiality and security are costly to install and maintain.	2	0.83	0	0.22	1	0.55
32	Using the EHR system will (has) increase(d) my productivity.	-4	-1.51	-3	-0.86	-5	-1.56
41	It is easy for me to become skillful in the use of EHR technology.	-2	-0.66	-1	-0.12	-3	-1.05

Note. Note. EHR = electronic health record. Consensus statements are those that do not distinguish between any pair of factors. All listed statements are nonsignificant at $p > .01$, and those flagged with an * are also nonsignificant at $P > .05$.

Statements 17 and 41 (see Table 51) reflected the attribute of technology in Factors 2 and 3 at a significance level of 95%, relating to the interface of EHR for the issue of connectivity to exchange data among entities and skills to operate an EHR system. Physicians in general found the system's interface did not give them the ability to exchange data at a single point. The physicians used different portals to log into separate systems for exchange of data. Statement 17 was agreed on among all three factors at a rating of +2, +4, and +2. Statement 41 with ratings of -2, -1, and -3 at a significance level of $p < 0.05$ related to easy acquisition of skills used with an EHR system. Thus, connectivity, time constraint in relation to productivity, and role of organizational support were agreed to for all three factors.

Summary

PQMethod 2.20 software (Schmolck, 2011) helped with the data analysis of this study. The analysis of correlation and factor extraction was first carried out using a comprehensive group of physicians, including all 35 respondents, irrespective of whether they had a system or not. Next, the analysis of correlation and factor extraction was separately performed for nonusers and users of the system out of the comprehensive group. A comparison of important perceptions among the participants helped answer the research questions. The extrapolated factors tapped into the common patterns in perceptions of the physicians in small medical practices.

The results expressed (a) what factors contributed as barriers to initial adoption of the EHR technology system and (b) what factors were important for continued acceptance or for postadoption of the system in the small medical practices. A set of 50 statements related to opinions on barriers to EHR system adoption and acceptance provided the groundwork to answer the research questions. The data analysis used physician respondents grouped according to the level of EHR technology usage. The opinions and perspectives were revealed with three extracted factors, both for barriers to the initial adoption and barriers to the postadoption or continued acceptance of EHR system. The determination of loadings for each factor were at a 95% level of significance with a value greater than 0.28 as per Equation 2 or at a 99% level of significance with a value greater than 0.37 as per Equation 3. Table 52 lists the loading for the three scenarios.

The three factors showed different combinations of barrier attributes. The factors had either a negative, positive, or neutral sensitivity with different attributes. Furthermore, the combination of attributes between nonusers and users of EHR systems in the physician community working in smaller practices showed multiplicity . A detailed comparative illustration for sensitivity for attributes is listed in Table 53.

Table 52

Summary of Factor Analysis for Different Types of Respondents

Factor	Participant type	Comprehensive	Nonuser	User
1	Explained variance	20	28	25
	Loadings at a significance ($p < 0.05$)	22	10	14
	Loadings at a significance ($p < 0.01$)	17	10	12
	Number of negative loadings	1	--	1
2	Explained variance	13	15	11
	Loadings at a significance ($p < 0.05$)	15	7	7
	Loadings at a significance ($p < 0.01$)	14	5	3
	Number of negative loadings	--	--	--
3	Explained variance	11	13	13
	Loadings at a significance ($p < 0.05$)	17	7	9
	Loadings at a significance ($p < 0.01$)	11	5	3
	Number of negative loadings	--	1	1

Note. -- = none.

The three factors for user and nonuser groups provided insight into the combination of attributes apparent as their preferences. Factor 1 differed for the two subgroups, reflecting that time constraint and changes related to processes and work practices were critical to the users of the EHR system. The concentration of postadoption attributes related to time barrier and change in work routine and processes. Factor 1 respondents, who were the nonusers of EHR system, perceived barriers within financial, time, technology, organization, and change categories. Nonusers were sensitive to ongoing costs and the time constraints associated with maintenance of digital records.

They perceived concerns for the interface of the technology and skills to operate and learn the system. The Factor 1 nonuser subgroup had reservations about trying new technologies. The change associated with redistribution of autonomy too was a concern for Factor 1 nonusers.

Table 53

Attributes Associated with Factors for Nonadopters and Adopters

		Factor								
		Comprehensive			Nonuser			User		
Barrier type	Level	1	2	3	1	2	3	1	2	3
Finance	Initial	--	S	I	--	I	S	--	--	--
	Ongoing	--	S	S	S	I		--	--	--
Time	Initial setup tasks	S	--	S	--	--		--	S	S
	Medical record maintenance	S	S	S	S	--	I	S	--	S
Technology	System (software/ hardware)	S	S	--	S	--	S	--	--	--
	Interface and skills	S	S	S	S	S	S	--	--	--
Organizational	People and culture	S	PA	PA	S	--	PA	--	S	PA
	Management	--	--	PA	--	PA	S	--	S	PA
Change	Processes and work practices	--	--	--	--	--	--	S	--	--
	Autonomy redistribution	S	I	--	S	--	I	--	--	--

Note. -- = attribute had no significance; S = sensitive, attribute was considered as a concern; I = insensitive, attribute was not a concern; PA = positive association, factor was supported.

Factor 1 for the comprehensive group of the physicians irrespective of their technology usage status revealed following concerns for different barriers: (a) time required for initial planning and implementation of the EHR system and time required recording the information into the system; (b) system-related technology, hardware, software, software's interface, and personal technical skills and proficiencies; and (c) the culture of personal innovativeness and (d) autonomy.

Thus, Factor 1, with the maximum variance of 20% for the comprehensive group, 28% for the nonusers, and 25% for the users of EHR, presented different perspectives for the system adoption and usage. The users of the system were not concerned with financial elements and technology proficiencies. The financial barriers, such as initial investment, had already been overcome and were not a top-level concern. The processes and work practices related to technology implementation were a concern for the users. The time constraint associated with the digitization of the records was another concern at the postadoption phase. Nonusers had concerns in each category of the five barriers. The comprehensive group showed concerns for the technology, time constraints, culture of innovativeness, and autonomy. The comprehensive group did not prominently reflect on financial concerns.

Factor 2 differed for the two subgroups, the nonuser and the user. The user of the system reflected a negative association with the organizational factor. This might be indicative of a renewed need for added training and support desired by the users of the system, especially in a postadoption phase. The additional training and support could achieve maximization of the level of system usage for recording and reporting of the information. Thus, the attitudes of the users of an EHR system reflected a concern for the time it took to maintain the digitized medical record postadoptively and having to confront the training and support issues from internal and external organizational elements.

The nonusers were insensitive to the financial factors of cost, investment, and losses because of the productivity changes. Factor 2 nonuser respondents were concerned about technical skills and proficiencies to operate the EHR system. The Factor 2 nonuser subgroup believed support from management was critical for adoption of the system. This group of physicians may be willing to pay extra for the system and its support to overcome their vulnerabilities with learning the skills.

Factor 2 for the comprehensive group of the physicians illustrated insensitivity to autonomy-related concerns. They also believed in organizational factors, especially that management-related attributes played a higher role in the adoption and usage of the EHR system. The respondents of this group had concerns with the technology system as well as with the skills required to work with the system.

Factor 2 had 13% variance for the comprehensive group, 15% variance for the nonusers, and 11% variance for users of EHR. The users of the system were concerned with the increased time needed to complete the digital record maintenance and added need for an organizational culture for ongoing training and support to use the system more effectively. Nonusers had concerns with skills associated with the technical system. They were organizationally positioned and perceived a higher adoption rate as long as there is a culture of management support. The nonusers were not sensitive to the costs associated with the EHR system. The insensitivity to the costs and incentives were contrary to the results observed in previous research (Boonstra & Broekhuis, 2010; Kaushal et al., 2009; Rao et al., 2011; Simon et al., 2007). The insensitivity to the cost and return on investment by imminent adopter was also suggested in Menachami's (2006) study. The comprehensive group showed concerns for the technology, time to maintain the electronic records, and financial responsibilities associated with adoption and usage of the system. The comprehensive group for Factor 2 did not care about loss of autonomy. The comprehensive group associated EHR success with organizational factors, especially related to management support in the attitudes of Factor 2 physicians. The belief for supportive organizational factors would lead to a better experience of adoption was also evident in the nonuser group and comprehensive group.

Factor 3 of the EHR user group reflected a concern for the time barrier but showed a positive association with the elements of the organizational factor. Factor 3 respondents, who were the nonusers of an EHR system, perceived barriers with the first time costs, technology's interface, and management's support within the organizational barrier. The Factor 3 nonusers were not so concerned about the extra time required to complete the digital record and change in autonomy redistribution. Factor 3 for the comprehensive group revealed barriers of concern: ongoing costs of an EHR system, time required in setting up the new system, extra time commitment needed for electronic documentation, and the skills associated with the technical system. The Factor 3 respondents associated positively with the organizational culture of personal innovativeness and management support.

Factor 3 had 11% variance for the comprehensive group, 13% variance for the nonusers, and 13% variance for users of EHR. The perspectives presented for the system acceptance and diffusion showed sensitivity to the time barrier for the user subgroup and comprehensive group. The comprehensive group was similar to the users' group in their attitude toward the organizational factors. The nonusers were not concerned with the time constraint and had concerns for management-related support. The comprehensive group showed a positive association with the process change expectations. The autonomy insensitivity was evident for the nonuser subgroup in Factor 3.

The investigator in this study assumed that the nonusers of EHR would show the characteristics of a preadopter, whereas the user of EHR corresponded with characteristics of a postadopter. The three extracted factors of nonusers demonstrated what perspectives were critical to a physician who had yet to adopt the technology. The composition of the three factors of the user subgroup demonstrated the criticality of attributes in the postadoption phase of the technology implementation.

Factor 1 for nonusers had a combination of attributes affecting their decision on the adoption of the system. These were ongoing costs in the categories of finance, extra time requirement to maintain the medical record in the time category, technology purchasing and technical proficiency along with interface-related issues in the technology category, lack of an innovative culture at the organizational level, and changes in the autonomy redistribution. Factor 1 for users showed insensitivity to the elements of financial investment and technical skill proficiency. Postadoption barriers related to process changes and alignment of work practices with the new technology. The need for more time to complete the same set of tasks seemed be another postadoption barrier for the Factor 1 user subgroup.

The nonuser physicians who represented the Factor 2 beliefs were not so concerned with the financial elements of EHR adoption. Their beliefs supported the need for organizational support for successful adoption of the technology. This group of physicians was vulnerable to the skills needed for the technical system. The postadoption attributes represented by the users of EHR stressed on the time constraint as a barrier for Factor 2. These individuals also had negative experiences with management and cultural elements of training and support after the adoption of the system.

The Factor 3 beliefs of nonuser physicians reflected on the interface issues with the technology. They showed a concern for the costs and had reservations about the organizational elements of support and culture. These individuals were not concerned about the need of a time in the EHR implementation. Thus, preadoption barriers of importance for Factor 3 individuals were finance, technology, and organization. The postadoption attributes reflected on time as a constraint but felt that organizational support was needed and available.

In conclusion, the postadoption attributes of importance for all three groupings of physicians who had been using the system in the past 5 years related to the time factors, process changes and work routines, and culture of support and training within the organization. The physicians currently using grouped as follows: (a) time and change in process related to work routine being a concern, (b) time and culture of support and training from the management being a concern, and (c) time a concern but organizational support a facilitator. Similarly, the preadoption attributes of importance were as follows: (a) sensitivity for ongoing costs, time sensitivity for maintenance of medical records, overall technical concerns, culture of innovation a limitation, and insecurities for changing autonomy; (b) insensitivity to the financial element, sensitivity for technical skills, organizational support, and culture a valuable positive; and (c) time insensitivity, technical interface concerns, concerns for management support, and financial costs.

Chapter 5: Summary, Conclusion, and Recommendations

Introduction

The rate of adoption of EHR technology has been slow in smaller practices due to a number of barriers. These barriers existed at individual and organizational levels. Furthermore, it was necessary to determine whether all barriers had the same priority with independent physicians working with different resources and level of personal skills. The problem addressed in this study was the assessment of attributes that would influence the adoption of an EHR system by the nonuser of the EHR system and acceptance of the system for continued usage for the user of the EHR system in the future.

The critical mass using a technical system is determined by the social changes made in response to the problem or issue on hand. McGinn et al. (2011) considered perceptions for barriers to EHR technology in different user groups of the medical profession: physicians, nurses, physician assistants, medical technicians, and other medical professionals. The authors stated that all barrier categories were recognized as barriers by some and as facilitators by others. These were (a) design or technical concerns, (b) privacy and security concerns, (c) cost issues, (d) lack of time and workload, (e) motivation to use EHR, (f) PEOU, (g) patient and health professional interaction, (h) interoperability, (i) and familiarity or ability with EHR. The physician group, according to McGinn et al., associated barriers to cost, design, and technical issues. Other studies (Rao et al., 2011; Simon et al., 2007) discussed issues faced by physicians practicing in small-sized medical offices. Rao et al. (2011) concluded that financial concerns were supported by concerns for finding the right system. Simon et al.

(2007) stated that the financial barrier was accompanied by concerns of workflow and privacy issues in smaller practices.

Attributes other than personal traits affecting adoption and usage of the EHR system have been captured within the framework of the DTI (Rogers, 2003). The personal traits have been captured with the TAM (Davis et al., 1989). The two subgroups of physicians helped understand the attributes affecting EHR adoption and future usage perceptions of nonusers and users of the EHR systems. The results and findings of the study addressed the following research questions:

1. What subjective perceptions might help overcome the adoption barriers of EHR technology in small medical practices of up to five physicians?

2. What subjective perceptions might help overcome the postadoption barriers of EHR technology in small medical practices of up to five physicians?

3. How might physicians use the ranking of observed subjectivity to get empowered for a successful adoption and implementation of EHR?

Q-methodology was instrumental in understanding the subjectivity in the viewpoints of nonusers on barriers for adoption of EHR technology. Similarly, the subjective viewpoints of users of EHR systems helped in understanding the postadoption barriers for future diffusion of the EHR technology. A pilot study preceded the actual data collection. An analysis reflecting different combinations of attributes represented the subjectivity among physicians. The similarities and dissimilarities of viewpoints were illustrated by three factors. The factors incorporated different perspectives whether one was a user of the system already or a nonuser.

The perspectives supported by the users of an EHR system connected with the postadoption factors. The three factors that dominantly explained the perspectives for user subgroup were (a) time constraint and process change, (b) time constraint and a need for better organizational culture and support, and (c) support for organizational factors with concerns for time constraint. Technology, autonomy, and financial barriers did not decisively factor into the postadoption phase of usage.

Similarly, perspectives supported by the nonusers of EHR system were linked with the preadoption factors. The groupings of physician perspectives for preadoption attributes were: (a) concern for financial, time, technology, organizational, and change related to autonomy redistribution; (b) concern for proficiency with technical skills, insensitivity to financial elements, and organizationally supportive; and (c) insensitivity autonomy redistribution, propensity to learn and try technical skills, concern for system issues, and insensitivity to time constraints. The nonuser or preadopters differed from each other because of different attitudes toward barriers of financial, time, and autonomy changes.

The interpretation of data and a discussion on the results using the theoretical framework of DTI and TAM are included in Chapter 5. The implications of the results, especially with regard to overcoming barriers by better planning of EHR system adoption, are discussed as well. The results are considered from a social change perspective along with recommendations for future research.

Interpretation of Data Analysis and Its Theoretical Implication

The results suggest that not all barriers had the same priority for every physician working independently in a small medical practice. Although prior studies were able to provide broad categories of barriers for EHR adoption and usage, they did not suggest how they were important for different individuals. The factors for all or comprehensive group of respondents of this study had a different mix of attributes than the users and nonusers of the EHR.

The comprehensive group prioritized the attributes with these three factors: (a) technically inexperienced, time conscious, and autonomy sensitive physicians; (b) financially conscious, open to learn and try technical skills, and autonomy insensitive; and (c) organizationally encouraged but technically and time challenged. These results suggest that users and nonusers differed in their perspectives about adoption and future usage by having a different sensitivity to the factors of barriers. The composition of perspectives included different combination of factors affecting their behavior.

The comparison of factors for subgroups provided an understanding of how the opinions differed between the users and nonusers. The three factors for nonusers were (a) concern for financial, time, technology, organizational, and change of autonomy redistribution; (b) concern for proficiency with technical skills, insensitivity to financial elements, and organizationally supportive; and (c) insensitivity to change in autonomy redistribution, propensity to learn and try technical skills, concern for system issues, and insensitivity to time constraints. The respondents had been using the EHR system for up to 5 years in their practices. This subgroup of physicians presented opinions reflecting the barriers at the postadoption phase. These factors were the following: (a) time as a constraint and process change concerned; (b) time sensitive and needing organizational culture and management support; and (c) technologically inexperienced, time conscious, and organizationally encouraged.

Factor 1 Attributes Among Users and Nonusers

The attitudes of nonusers showed barriers in all the five factor categories used in the study. The five factors and their sublevels connected to the Mustonen-Ollila and Lyytinen's (2003) DTI framework of 28 factors. The attitudes of nonuser Factor 1 respondents were also evident in the Viswanath and Scammura (2007) study. Viswanath and Scammura concluded that financial concerns accompanied by a lack of perceived ease of use without much support at the organizational level have been a cause of reservation in the adoption of technical systems.

The statistical and empirical evidence for the nonuser subgroup reflected technology skills, especially computer experience, to be an adoption concern. The technology interface was perceived to be complex as it required more time and technical skills to connect and share information among involved parties. Lack of confidence with technical skills, interface issues, and interoperability concerns directly added time limitations. Time constraints affected productivity, resulting in undesirable financial consequences. A concern for autonomy in decision making resulted in reduced perceived relative advantage. Providing quality one-to-one training on the software interface and meshing the technology with work routines might reduce the negative impact of the barriers.

The attributes evident for Factor 1 users of an EHR system were different than those of the nonusers. The postadoption attributes that were reflected in user physicians' perspectives comprised a concern for change with processes with the use of EHR technology. The alignment of processes with the technical system received a negative rating. The change element, especially with processes, was supplemented with added time constraints associated with the use of an EHR system. The attributes reflected for Factor 1 users of EHR were in concurrence with Tulu et al.'s (2006) study. Tulu et al. suggested that the work styles of the users needed to be compatible with the information system. The authors had concluded that, if there were inconsistencies with system design and work practices, it led to unwanted time commitments. The attribute of process change was unique to postadoption barriers, whereas the attribute of financial cost was important to the preadopters.

Factor 2 Attributes Among Users and Nonusers

The statistical and empirical evidence for the nonuser subgroup reflected a belief in the organizational attribute. The Factor 2 nonuser respondents held the belief that management, people, and culture had a positive effect on EHR adoption. The perspective that organizational factors were important was supported by conclusions reached by Kaushal et al. (2009) in their investigation. Kaushal et al. concluded that medical practices on their own have been influencing the decision of implementation and usage of an EHR system, thus implying a favorable role of organizational factors. Thus, Factor 2 nonuser physicians positively associated with organizational norms but negatively associated with learning skills of the technology. The concern with technical skills reflected the psychological nature of a personal trait. Yi et al. (2005) discussed the personal norms and behaviors that affect technology diffusion. Personal innovativeness in the domain of information technology has been a determinant of diffusion of an innovation (Yi et al., 2005). Factor 2 nonusers were insensitive toward the financial element. Prior studies (Boonstra & Broekhuis, 2010; Kaushal et al., 2009; Rao et al., 2011; Simon et al., 2007) with adoption and usage indicated that financial concerns were barriers to adoption and acceptance. Thus, an attitude of insensitivity for financial costs might be an indirect consequence. Determination of factors that would make financial costs secondary for adoption could be tested in a future study.

The attributes evident for Factor 2 users of an EHR system were different than those of nonusers. The postadoption attributes that were reflected showed a concern for the time element with the use of an EHR system. A need for enhanced organizational support both internally and externally was also reflected in the attitudes of Factor 2 users.

The nonuser and user Factor 2 respondents differed in polarity regarding their beliefs for organizational support. The two subgroups were not only bipolar for organizational attribute, but they had a different perspective on attributes related to time and technology skills. The users of the EHR system were concerned about the time factor, whereas the nonusers were concerned about the technical skills. Insensitivity for the financial factor was a contra-indication to conclusions. Factor 2 for the comprehensive group was characterized by the personal trait that appreciated trying and learning of new technical skills but had concerns for system interface and connectivity, financially sensitive, and insensitive to autonomy changes. Technical skills required to completely manage the EHR system were a concern shared by the comprehensive group and nonuser group. It had no attribute in common with the user group of physicians.

Factor 3 Attributes Among Users and Nonusers

The statistical and empirical evidence for the nonuser subgroup reflected a belief in acquiring and learning new technical skills. The attitude of Factor 3 nonuser physicians showed that they could learn new technical skills; however, they were not very satisfied with the software interface and interoperability between systems. Thus, Factor 3 respondents believed in a culture of personal innovativeness in the domain of information technology through having a positive psychology to learn new technologies; the system-related issues were a barrier for them (Yi et al., 2005). The financial cost and management-related support concerns were evident in their perspectives. The change attribute, especially redistribution of autonomy, was not a concern for this group of respondents. The profile of these physicians reflected awareness for innovativeness to learn a new technology, but it showed concerns for training and support at the management level. Personal traits related to technology were positively evident in their perspectives.

The attributes evident for Factor 3 users of an EHR system were different than those of nonusers. The postadoption attributes that were reflected in the group of user physicians related to technology issues and a concern for the time element. Factor 3 respondents in the user group had positive experience with organizational support from management and external agencies. The users associated a concern with the time attribute and nonusers with finance and technology attributes. Factor 3 for all respondents was characterized by attributes of a technical sensitivity, time sensitivity, and supportiveness for organizational factors. The Factor 3 attributes for all respondents showed a commonality with attributes presented by the user subgroup.

Summary of Factor Interpretation

The users of EHR systems were concerned with the attributes of process change, time constraint, and organizational culture and management support. These results were in concurrence with earlier findings (Kaushal et al., 2009; Tulu et al., 2006). The nonusers of EHR systems echoed in their perspectives concerns for technology skills and issues with connectivity and sharing of information. Furthermore, organizational elements were a concern for the nonuser group of physicians. The respondents in different factors showed different sensitivity to financial, time, and autonomy redistribution changes. Although the results demonstrated by the nonuser subgroup of physicians were in concurrence with the conclusions made by Boonstra and Broekhuis (2010), Kaushal et al. (2009), and Tulu et al. (2006) for Factors 1 and 3, the financial insensitivity of the Factor 2 group has seldom been discussed. The factors echoed in their perspectives of the comprehensive group of physicians were closer to concerns of the nonuser group. They included concerns for finance, technology, time, and change in autonomy. Change related to processes and work practices did not surface in any perspective. Organizational support was critical to only Factor 3 respondents.

Implications

Agarwal et al. (2010) suggested that paper charts were one of the causes of inefficiencies and suboptimal care in medical care. Ilie et al. (2009) reported that the U.S. Department of Health and Human Services could save up to $140 billion a year with the use of EHR technology. Agarwal et al. reported that approximately $27 billion has been available in incentives through Medicare and Medicaid reimbursement systems for health providers for the use of EHR technologies. Up to $48,400 could be received by a practice for adoption of an EHR system. The implication of the results of this Q-methodology study was to let physicians in smaller practices develop strategies based on the findings of the study. Each barrier factor has an importance for an individual, and it could be primary or secondary in nature (Boonstra & Broekhuis, 2010).

Countries like the United Kingdom have used a top-down EHR implementation strategy (Cresswell, Worth, & Sheikh. 2012). According to Cresswell et al. (2012), the National Health System in the United Kingdom provided three commercial systems like Lorenzo, Cerner Millennium, and RiO to convert paper charts to an electronic format. The disadvantage of using a single system has been that the design of the system needed to deal with requirements of multiple stakeholders at different levels of the service. Another drawback with a single EHR system was that customization of the system with work practices was time-consuming (Cresswell et al., 2012). As implementation of a single system was not the case in United States, factoring subjectivity on barriers for adoption and postadoption usage could benefit healthcare with improved levels of shared information to reduce redundancies in delivery of care. A higher level of adoption and usage of EHR system could benefit physicians, streamline documentation for their own patients, and participate in the CMS pay-for-performance incentives.

Recommendations for Action

A nonuser physician who showed sensitivity for ongoing costs, technical attributes, and culture of innovativeness in the domain of information technology could use tools that support detailed guidance and support from HIT vendors and other health information exchanges for information on functionalities of the system and vendor characteristics. The information from vendors could be broken down into (a) level of functionality, (b) expected skills needed, (c) time requirements, and (d) support provided by the vendor’s training team. A modular implementation for this group of physicians could start at a basic level. The level of functionality appropriate for the initial level of implementation would reduce the gap in technical, organizational, and process change.

This group of physicians would best adopt the EHR system in an incremental-step manner. The acquisition method could involve leasing the system from the affiliated hospital. This alternative would avoid any connectivity issues and large financial implications. An alternative would be to contract with an EHR vendor for a web-based solution. The second alternative might not always resolve the connectivity and interoperability issues.

A nonuser physician who is technically stressed but believes in aligning the organizational structure and management support to solve challenges with a technical system could go for an in-house or web-based system. A team approach that empowers a member of the team to learn the system and then take the leadership to teach others may be a valuable strategy. This strategy would require good time management skills and a detailed road map from the vendor on the implementation of the system and training of a smaller group of individuals.

The postadoption barriers in the form of process changes and alignment and time constraint would best be avoided if vendors and their project team actually spent time understanding the details of the work practices before the installation of the system. A detailed analysis of the utility of functions of an EHR system with the work practices could eliminate unnecessary frustration caused by less utilizable functions. The workaround for any process incompatibility could be developed with the help of the physician and staff in small practices. Increased participation to figure out the workaround and training of such workaround would save time and increase acceptability at a higher rate.

Future Research

Q-study has been well suited to generate a hypothesis for further investigation. This study was able to group physicians based on their subjectivity on barriers to EHR adoption and acceptance; future research could classify EHR usability and its consequences. Hardly any studies have looked into how the level of functional use of EHR correlated with the outcomes of productivity, communication, quality of care, quality of information sharing, and patient and physician satisfaction. Although this study found similarities and differences between perspectives of physicians regarding adoption and usage of the EHR technology, future research should investigate when financial barriers would become secondary. Furthermore, interoperability between systems, an attribute of compatibility, a reported limitation could be investigated for increased diffusion of the systems. Future research investigating the correlation between interoperability of systems and EHR user productivity could help understand the issue of HIT diffusion. Furthermore, to maximize EHR acceptance through increased use, it would be necessary to know how interoperability and customization relate to EHR usability. An orderly understanding of different functions of EHR and associated magnitude of process change in terms of tangible and intangible consequences could be valuable to a professional office.

Conclusions

A patient's medical history is recorded and chronicled in a medical record, thus it is considered to be an important tool in providing healthcare (Cantiello & Cortelyou-Ward, 2010). Policies are being placed by the federal and state governments to push the use of EHR technology by the year 2014 (Cantiello & Cortelyou-Ward, 2010; Morton &

Wiedenbeck, 2010). The push has been to reap the benefits of reduced and better managed costs by eliminating redundancy and having fewer errors, faster accessibility of information, and wider accessibility of quality data for future research (Boonstra & Broekhuis, 2010). Although the listed benefits are remarkable, there has been resistance to introducing these systems into hospitals and physician offices. Resistance is being attributed to the interruption of routine work practices, technology-specific issues, benefits not been empirically documented, lack of standardization in the development of the systems, and the personal traits of the users (Boonstra & Broekhuis, 2010; Castillo et al., 2010; Westbrook et al., 2009). Different categories of barriers have been listed relating to the slow rate of adoption of an EHR system. The problem for many physicians, especially in small-sized practices, however, lies with their inability to customize implementation solutions by managing the preadoption barriers determined based on their beliefs. A similar challenge is faced during the postadoption phase of integrating the system into their work environment. Earlier studies grouped them all into factors of resistance or barriers without associating them to specific stages of adoption or usage.

The findings of this Q-methodology study supported the list of barriers suggested by previous studies. The empirical data and interpretation suggested that independent physicians in smaller practices related the preadoption barriers of finance and technology in conjunction to beliefs about organizational culture and support as well as issues of change. The postadoption barriers were more in line with the process change management and associated time factor. Similarly, the postadoption barriers of process and time management concurred with organizational culture and support attributes. In conclusion, maximizing the social change in the healthcare industry through better access and sharing of critical health information could be made possible by training physicians not only with technical skills but also with simpler and cleaner processes and an organizational change road map.

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Appendix A: The Q-Concourse

No.	Factor Level	Theoretical Factor	Q-Concourse	Source
1	a	Relative Advantage	Changed to: The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier	Rao et al., 2011; Boonstra & Broekhuis, 2010; Kaushal et al., 2009; Simon et al., 2007
2	a	Relative Advantage	Uncertainty about return on investment is a major barrier	Rao et al., 2011; Boonstra & Broekhuis, 2010; Kaushal et al., 2009; Simon et al., 2007
3	h	Compatibility	Resistance to adoption from practice physicians is a major concern	Rao et al., 2011
4	e	Complexity	Capacity to select, contract, and install is a major concern Changed to: Capacity within my practice to select, install, and contract for an EHR system is (has been) a major concern.	Rao et al., 2011; Menachemi, 2006
5	b	Relative Advantage	Loss of short-term productivity is a major concern during transition	Rao et al., 2011; Simon et al., 2007; Menachemi, 2006
6	b	Relative Advantage	Loss of long-term productivity is a major concern during transition	Rao et al., 2011; Simon et al., 2007
7	a	Compatibility	Confidentiality and security add more costs to a computer system, hence cause a bigger problem to install and maintain in a small practice	Valenta & Wigger, 1997
8	e	Complexity; PEOU	Finding a CCHIT certified EHR is (has been) a concern as there are so many vendors in the market and there is no way of knowing which of these companies will be in existence after 10 years.	Rao et al., 2011

9	e	Relative Advantage; PU	Is obsolesce of the system in near future a major concern	Rao et al., 2011
10	i	Relative Advantage; PU	Diagnostic systems are best used in teaching, not in practice	Valenta & Wigger, 1997
11	i	Relative Advantage; PU	Positive impact on quality of communication with other physicians	Rao et al., 2011
12	d	Relative Advantage	Positive impact on quality of communication with patients	Rao et al., 2011
13	d	Relative Advantage; PU	Positive impact on prescribing medication	Rao et al., 2011
	b	Relative Advantage; PU	Positive impact on meeting guidelines for delivery of preventative care; CMS incentives	Rao et al., 2011
15	d	Relative Advantage	Avoidance of allergic reaction	Rao et al., 2011
16	d	Relative Advantage; PU	Better management of critical laboratory test result	Rao et al., 2011
17	e	PIIT	Vendor treatment of small practices is not of the same quality as that of large hospitals/practices	Rao et al., 2011
18	b	Relative Advantage	Smaller operating margin require higher efficiency expectancy	Rao et al., 2011
19	h	PIIT	Received essential guidance or explanation on how to adopt paper-based processes into EHR environment	Amatayakul, 2011; Boonstra & Broekhuis, 2010
20	f, i	Compatibility	EHR system design requires an alignment with workflow and clinical-thought-flow with service provider	Amatayakul, 2011; Boonstra & Broekhuis, 2010
21	c	Compatibility	I have concerns if my standalone EHR system becomes obsolete, how would I import old charts into the new system.	Callan & DeShazo, 2007

22	g	PIIT	There is a need for the buy-in by staff to make them willing to accept and adopt to the change	Callan & DeShazo, 2007
23	e	Compatibility	The ability to interface with hospitals is the biggest advantage of EHR systems to our offices.	Callan & DeShazo, 2007
24	g	PIIT	Physician's own practice group as an organization influenced the EHR adoption decision rather than an external agency	Simon et al., 2007
25	g	PIIT	Role of external organizations influenced the EHR adoption	Simon et al., 2007
26	f	Complexity; PEOU	Technical factors, such as, computer skills, lack of technical support, and limitation of technical system is a barrier	Kaushal et al., 2009; Simon et al., 2007
27	g	PIIT	Organizational factors such as a culture of innovation and change, leadership, infrastructure support, and open communication play a critical role in how fast the EHR technology will be adopted	Simon et al., 2007
28	c	Complexity	Entering data into the computer during conversion of paper charts to electronic charts is cumbersome and time consuming	Menachemi, 2006
29	i	Compatibility	Disrupts work flow and the physical layout of the physician's office	Menachemi, 2006
30	f	Complexity; PEOU	System is difficult to use	Menachemi, 2006
31	f	Complexity; PEOU	Lack of uniform data standards for the industry makes exchange of data difficult. My staff and I	Kaushal et al., 2009; Menachemi, 2006

			work with a number of portals to gather patient data as EHR to EHR interconnectivity is not always available.	
32	f	Complexity; PEOU	Me and my staff do not have technical ability to use the system	Kuashal et al., 2009
33	b	Complexity; PU	Loss of data in a disaster situation	Menachemi, 2006
34	h	Relative advantage	I believe that all stakeholders' interested in promoting EHR use, such third-party payers, IT vendors and the federally designated quality improvement organizations have the right focus. They are using their limited resources where they are likely to bear the most fruits and all of them have the same goals of quality	Menachemi, 2006
35	b	Relative advantage	Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption by physicians	Menachemi, 2006
36	d	Complexity; PEOU	Physicians find lack of time to acquire knowledge about the system a barrier to adoption	Kaushal et al., 2009
37	b	Relative Advantage	Perception that EHRs will have negative or no impact on healthcare cost	Kaushal et al., 2009
38	j	Perceived usefulness	Using EMR may decrease my control over clinical decisions	Walter & Lopez, 2008
39	j	Perceived usefulness	Using EMR can decrease my control over each step of patient care process	Walter & Lopez, 2008
40	j	Perceived usefulness	Using EHR may increase monitoring and reviewing of diagnostic and therapeutic	Walter & Lopez, 2008

			decisions by non-providers resulting in greater invasion into my style of providing treatment	
41	a	Relative Advantage	Financial incentives can clearly modify EHR adoption behavior. Even small incentives correlate with decisions for adoption for an imminent adopter	Kaushal et al., 2009
42	h	Compatibility	The most common reason for implementation failure is that implementation process is treated as a technological process, human and organizational issues are ignored	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
43	i	Relative Advantage; PIIT	The goals for EHR implementation are to enhance Healthcare quality and patient safety, improve work quality and work reliability, improve information sharing and communication, and reduce work steps and errors	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
44	h	PIIT	Top management used project manager or a manager to do the preliminary work to define the goals	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
45	f	Complexity	Issues with integration of billing system with EHR implementation	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
46	c	Complexity; Relative Advantage	Underestimation of amount of work required during implementation of EHR Changed to:	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
47	g	PIIT; PEOU	Top management’s response to training for EHR has been critical to the success of EHR implementation.	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
48	i	PIIT	Hands-on training for employee or individuals with similar needs	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009

49	i	Compatibility	Criticality of pre and post work analysis; work sampling techniques	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
50	d	Compatibility	Physician spend same amount of time with each patient, but spend more time on computer rather than dictating or writing and signing	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
51	d	Compatibility	Clinical staff spent more time with the patient, less time on transporting charts, maintenance of general office task, but more time on management of the medical system	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
52	d	Relative Advantage	EHR enhances internal messaging within the practice	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
53	c	PIIT	Timely record conversion and maintenance in an EHR implementation requires analysis of needs and preferences of the medical providers and key administrators.	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
54	h	PIIT	A successful EHR implementation requires a strong physician champion	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
55	a	PIIT	A successful EHR implementation requires a project team consisting of key clinical, office, and technical system staff adding additional costs to adoption of this technology.	Carayon, Smith, Hundt, Kuruchittam, & Li, 2009
56	f	Perceived ease of use	I find EMR flexible to interact with	Boonstra & Broekhuis, 2010; Seeman & Gibson, 2009
57	f	Perceived ease of use	I find EMR to ease to use	Seeman & Gibson, 2009
58	i	Perceived ease of use	I find it easy to get EMR to do what I need it to do in my patient care and	Seeman & Gibson, 2009

			management.	
59	f	Perceived ease of use	It is easy for me to become skillful in use the EMR technology.	Seeman & Gibson, 2009
60	i	Perceived ease of use	Learning to operate EMR is easy for me. My interactions with EMR are clear and understandable.	Boonstra & Broekhuis, 2010;
61	j	Perceived usefulness	I would find EMR advantageous for medical profession as a whole	Walter & Lopez, 2008
62	i	Compatibility	Concerns about negative impact on workflow causes uncertainty about the use of EHR	Castillo et al., 2010
63	a	Perceived usefulness	The cost of physician time and change in practice patterns have been identified as significant barriers to EHR adoption.	Yarbrough & Smith, 2007
64	i	Perceived usefulness	The CMS pay-for-performance demonstration appears to have prompted positive operational changes in practices	Felt-Lisk et al., 2009
65	d	Perceived usefulness	The CMS pay-for-performance related changes have resulted in improved documentation and has been inconsistently applied based on practitioner and staff time.	Felt-Lisk et al., 2009
66	d	Perceived usefulness	Using EMR enables me to complete patient encounter more quickly	Seeman & Gibson, 2009
67	e	Personal innovativeness in the domain of IT	Information and support from physicians who are already EHR users has been very helpful. It was (is going to be) instrumental in my selection of the system.	Boonstra & Broekhuis, 2010
68	j	compatibility	Codification of physician knowledge and the problem solving process is	Walter & Lopez, 2008

			threatening to their professional autonomy	
69	e	Compatibility	Concerns about ensuring EMR system meets privacy and security requirements before implementation.	Boonstra & Broekhuis, 2010
70	g	Personal innovativeness in IT	Information and support from physicians who are already users.	Boonstra & Broekhuis, 2010
71	b	Relative Advantage	Using the system in my practice increased my productivity	Tulu et al., 2006
72	f	Complexity	Learning to operate the system was easy for me	Tulu et al., 2006
73	f	complexity	It is not easy for me to become skillful at using the system	Tulu et al., 2006
74	i	Compatibility	Using the system fits with the way I work	Tulu et al., 2006
75	i	Compatibility	Using the system does not fit with my work practice preference	Tulu et al., 2006
76	i	Compatibility	Using the system fits with my service needs	Tulu et al., 2006
77	f	Complexity	I can use the system easily while I perform a medical evaluation procedure	Tulu et al., 2006
78	i	Compatibility	I found the system to be quite flexible in terms of how I like to conduct medical evaluation	Tulu et al., 2006
79	i	Compatibility	The way the system is designed is inconsistent with how I like to conduct medical evaluation	Tulu et al., 2006
80	J	Compatibility; PIIT	EHR system may help laypersons and subordinate paraprofessionals gain greater access to the abstract knowledge possessed by physicians which is helpful to my practice	Walter & Lopez, 2008

81	j	Compatibility; PIIT	Fear of professional autonomy redistribution adds resistance to adoption from practice physicians.	Walter & Lopez, 2008
82	f	Complexity	I expect to continue using the system in my practice	Tulu et al., 2006
83	f	Relative Advantage; PU	Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system.	Tulu et al., 2006
84	b	Relative Advantage; PU	Systems like this are a distraction to the physician's main job of providing care to patients	Tulu et al., 2006
85	d	Complexity	The process of preparing an submitting patient evaluation through the system is easy for my office to handle	Tulu et al., 2006
86	d	Complexity	Using the system requires lot of extra effort in my practice. I needed more employees than before to complete the same types of clinical tasks	Tulu et al., 2006
87	i	Compatibility	It has been easy to tailor the system to how my practice handles reports	Tulu et al., 2006
88	g	PIIT	If I heard about a new information technology, I would look for ways to experiment with it	Yi et al., 2006
89	g	PIIT	In general, I am hesitant to try out new information technology	Yi et al., 2006
90	g	PIIT	I like to experiment with new information technologies	Yi et al., 2006

Statements added to the Q-concourse based on pilot study recommendations

No.	Factor Level	Theoretical Factor	Q-Concourse	Source
91	J	Compatibility	EHR software leads to excessive use of guidelines, therefore, it is threatening to my professional autonomy.	Personal communication, 2011
92	h	PIIT	My practice is aware of the needs of techno-phobic employees and is in position to provide them with the needed resources.	Personal communication, 2011
93	h	PIIT	MY staff and I understood that a team approach would best serve the work flow effectiveness when using an EHR technology. We have (will) create such teams for best results.	Personal communication, 2011
94	e	Compatibility	I am aware that an EHR technology requires physicians and their assistants to align their clinical work flows with the system. The selected system provided the interface to include the important workflows.	Personal communication, 2011
95	j	Complexity; PIIT	Fear of loss of professional autonomy adds resistance to adoption from practice physicians.	Walter & Lopez. 2008
96	c	Compatibility; complexity	A standalone EHR is not going to solve the issue of interconnectivity with other physician offices and hospitals resulting in inefficiencies with data integration.	Personal communication, 2011

Note. EMR = electronic medical record; EHR = electronic health record; PU = perceived usefulness; PEOU = perceived ease of use; PIIT = personal innovativeness in information technology. Factor Levels of a to j as stated in Table 1

Appendix B. Q-Sample

No.	Factor-Level	Concourse Item No.	Statement
1	A1	1	The amount of capital and the availability of capital needed to acquire and implement EHR is a major barrier.
2	B1	18	A smaller operating margin related to EHR (electronic health record) adoption requires higher efficiency expectancy in all administrative and clinical work routines.
3	A5	35	Monetary incentive alone, such as pay-for-performance and discounted software programs, might ultimately achieve the next big wave of EHR adoption and acceptance by physicians.
4	J5	95	Fear of loss of professional autonomy adds resistance to adoption from practice physicians.
5	A2	41	Financial incentives can clearly modify EHR adoption behavior. Even small incentives correlate with decisions of adoption for an imminent adopter.
6	B4	2	Uncertainty about return on investment is a major barrier
7	C1	28	Entering data into the computer during conversion of paper charts to electronic charts is cumbersome and time consuming
8	D1	36	Physicians find lack of time to acquire knowledge about the system a barrier to adoption.
9	C2	46	My office has been (was) able to estimate in close approximation the projected time required to convert paper charts into electronic charts for the EHR system.
10	H1	34	I believe that all stakeholders' interested in promoting EHR use, such as third-party payers, IT vendors and the federally designated quality improvement organizations have the right focus. They are using their limited resources where they are likely to bear the most fruits and all of them have the same goals of quality.
11	I1	43	The goals for EHR implementation are to enhance Healthcare quality and patient safety through reduced work steps and errors
12	D2	66	Using EMR enables me to complete patient encounter more quickly
13	J1	91	EHR software leads to excessive use of guidelines, therefore, it is threatening to my professional autonomy.
14	C3	96	A standalone EHR is not going to solve the issue of interconnectivity with other physician offices and hospitals resulting in inefficiencies with data integration.

15	E1	23	The ability to interface with hospitals is the biggest advantage of EHR systems to our office.
16	H2	92	My practice is aware of the needs of techno-phobic employees and is in position to provide them with the needed resources.
17	F1	31	Lack of uniform data standards for the industry makes exchange of data difficult. My staff and I work with a number of separate portals to gather data as EHR to EHR interconnectivity is not available.
18	H3	42	The most common reason for failure of a technology implementation is that implementation process is treated as a technological problem, human and organizational issues are not fully addressed
19	G1	24	Physician's own practice group as an organization influenced the EHR adoption decision rather than an external agency.
20	B2	55	A successful EHR implementation requires a project team consisting of key clinical, office, and technical system staff adding additional costs in adoption of this technology.
21	I2	58	I find it easy to get EMR to do what I need it to do in my patient care and management
22	I3	87	It has been easy to tailor the system to how my practice handles reports
23	D3	12	There is a positive impact on the quality of communication with patients in the same amount of time when compared to paper charts.
24	E2	67	Information and support from physicians who are already EHR users has been very helpful. It was (is going to be) instrumental in my selection of the system.
25	I4	79	The way the system is designed is inconsistent with how I like to conduct medical evaluation
26	G2	22	There is a need for the buy-in by staff to make them willing to accept and adopt to the change
27	E5	64	The demonstration associated with CMS pay-for-performance appears to have prompted positive operational changes in practices
28	G3	27	Organizational factors such as a culture of innovation and change, leadership, infrastructure support and open communication play a critical role in how fast the EHR technology will be adopted.
29	B3	6	Loss of long-term productivity is a major concern during transition
30	A4	7	Confidentiality and security add more costs to a computer system, hence cause a bigger problem to install and maintain in a small practice

31	A3	5	Loss of short-term productivity is a major concern during transition
32	B5	71	Using the system in my practice has (will increase) increased my productivity
33	C4	53	Timely record conversion and maintenance in an EHR implementation requires analysis of needs and preferences of the medical providers and key administrators.
34	F2	83	Physicians should not be spending their time dealing directly with the technology aspects of the system as their office does not have the technical expertise to maintain such a system.
35	D4	86	Using the system requires a lot of extra effort in my practice. I needed more employees than before to complete the same types of clinical tasks.
36	D5	85	The process of preparing an submitting patient evaluation through the system is easy for my office to handle
37	E3	4	Capacity within my practice to select, install, and contract for an EHR system is (has been) a major concern.
38	E4	8	Finding a CCHIT certified EHR is (has been) a concern as there are so many vendors in the market and there is no way of knowing which of these companies will be in existence after 10 years.
39	I5	94	I am aware that an EHR technology requires physicians and their assistants to align their clinical work flows with the system; the selected system provided the interface to include the important workflows.
40	H4	93	My staff and I understood that a team approach would best serve the work flow effectiveness when using an EHR technology. We have (will) create(d) such teams for best results.
41	F3	59	It is easy for me to become skillful in use the EMR technology.
42	F4	77	I can use the system easily while I perform a medical evaluation procedure
43	F5	72	Learning to operate the system was/will be easy for me
44	G4	90	I like to experiment with new information technologies
45	G5	47	Top management’s response to training for EHR has been critical to the success of EHR implementation
46	H5	19	I did not /may not receive essential guidance or explanation on how to adopt paper-based processes into EHR environment

47	J2	80	EHR system may help laypersons and subordinate paraprofessionals greater access to the abstract knowledge possessed by physicians which is helpful to my practice.
48	J3	81	Using the EMR may decrease my professional discretion over patient care decisions
49	C5	21	I have concerns if my standalone EHR system becomes obsolete, how would I import old charts into the new system.
50	J4	40	Using EMR may increase monitoring of my diagnostic and therapeutic decisions by non-providers resulting in greater invasion into my style of providing treatment

Note. EMR = electronic medical record; EHR = electronic health record; Factor Levels of a to j as stated in Table 1with five instances for each, such as A1 to A5 all the way to J1 to J5 .

Appendix C: Correlational Matrix for Q-Sort: Comprehensive

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1	A1111U1	100	32	43	33	31	35	18	17	29	26	32	18	27	40	19	-1	5	24	12	43	31	25	40	26	17	39	35	20	27	7	29	20	20	23	23
2	A1112U2	32	100	26	37	23	40	33	45	30	13	30	8	24	22	33	18	-37	56	15	19	41	21	34	47	43	55	44	52	4	60	45	51	27	33	52
3	A1115U4	43	26	100	31	21	30	18	2	26	16	17	11	19	22	34	38	-16	17	13	6	-13	31	5	12	2	18	16	18	21	4	2	-12	2	11	10
4	A1117U5	33	37	31	100	30	36	13	32	36	9	24	35	3	36	40	31	-7	36	34	26	31	16	29	36	18	38	52	8	31	20	34	38	15	39	48
5	A1118U6	31	23	21	30	100	23	25	11	35	12	18	23	36	-17	1	31	0	13	21	14	30	-4	-1	15	14	16	34	1	2	13	44	4	-12	19	14
6	A1119U7	35	40	30	36	23	100	46	30	47	32	27	11	2	52	45	29	-24	28	13	34	34	12	31	34	23	37	46	39	22	37	34	30	25	38	44
7	A1121U8	18	33	18	13	25	46	100	24	23	33	25	23	26	15	15	18	-19	36	22	43	21	-2	17	19	33	44	25	35	6	41	34	18	-6	23	43
8	A1122U9	17	45	2	32	11	30	24	100	20	24	22	23	6	34	30	25	-24	39	28	39	36	8	42	52	16	61	60	48	19	54	56	54	30	43	55
9	A1127U11	29	30	26	36	35	47	23	20	100	23	35	26	7	50	60	42	-27	45	12	22	11	17	15	16	19	36	54	35	32	28	38	16	36	33	40
10	A1129U12	26	13	16	9	12	32	33	24	23	100	-2	39	6	19	22	43	-2	23	20	51	14	-4	8	27	16	33	17	15	-10	17	33	8	3	19	37
11	A1135U14	32	30	17	24	18	27	25	22	35	-2	100	-8	19	32	18	-3	-15	35	25	20	11	24	24	12	8	25	34	35	25	27	15	21	31	4	31
12	A1137U16	18	8	11	35	23	11	23	23	26	39	-8	100	-21	26	39	49	7	47	10	32	34	10	28	22	11	29	19	6	5	15	23	36	-17	29	42
13	A1138U17	27	24	19	3	36	2	26	6	7	6	19	-21	100	-14	-8	5	-2	5	18	1	12	-5	-7	11	-4	24	14	14	-15	10	13	-2	11	0	-5
14	A1139U18	40	22	22	36	-17	52	15	34	50	19	32	26	-14	100	64	17	-10	39	4	32	25	34	41	16	22	37	48	46	54	26	21	40	27	27	31
15	A1142U19	19	33	34	40	1	45	15	30	60	22	18	39	-8	64	100	31	-19	49	-3	12	26	32	34	27	14	36	30	36	50	31	13	37	30	50	38
16	A1143U20	-1	18	38	31	31	29	18	25	42	43	-3	49	5	17	31	100	-14	28	33	10	5	11	12	34	10	11	22	7	-5	24	31	15	-7	30	25
17	A1144U21	5	-37	-16	-7	0	-24	-19	-24	-27	-2	-15	7	-2	-10	-19	-14	100	-24	-16	-22	3	5	5	-30	-30	-26	-4	-23	13	-42	-14	-20	-27	-19	-39
18	A1147U22	24	56	17	36	13	28	36	39	45	23	35	47	5	39	49	28	-24	100	1	18	29	39	36	30	38	61	42	44	19	43	40	53	19	36	54
19	A1114N1	12	15	13	34	21	13	22	28	12	20	25	10	18	4	-3	33	-16	1	100	28	9	-3	15	28	16	12	13	8	3	12	39	22	0	9	18
20	A1116N2	43	19	6	26	14	34	43	39	22	51	20	32	1	32	12	10	-22	18	28	100	23	-4	29	25	23	38	45	30	12	42	33	32	2	19	50
21	A1120N3	31	41	-13	31	30	34	21	36	11	14	11	34	12	25	26	5	3	29	9	23	100	15	49	30	14	35	31	29	17	38	32	56	15	33	28
22	A1123N4	25	21	31	16	-4	12	-2	8	17	-4	24	10	-5	34	32	11	5	39	-3	-4	15	100	27	-7	23	7	24	36	31	9	2	27	2	45	4
23	A1124N5	40	34	5	29	-1	31	17	42	15	8	24	28	-7	41	34	12	5	36	15	29	49	27	100	41	20	42	38	33	39	47	28	65	35	49	33
24	A1126N6	26	47	12	36	15	34	19	52	16	27	12	22	11	16	27	34	-30	30	28	25	30	-7	41	100	9	51	40	24	-9	49	41	53	36	31	52
25	A1128N7	17	43	2	18	14	23	33	16	19	16	8	11	-4	22	14	10	-30	38	16	23	14	23	20	9	100	26	23	24	11	16	35	27	7	21	31
26	A1130N8	39	55	18	38	16	37	44	61	36	33	25	29	24	37	36	11	-26	61	12	38	35	7	42	51	26	100	59	43	12	53	53	58	30	36	61
27	A1131N9	35	44	16	52	34	46	25	60	54	17	34	19	14	48	30	22	-4	42	13	45	31	24	38	40	23	59	100	58	32	52	58	47	34	38	57
28	A1132N10	20	52	18	8	1	39	35	48	35	15	35	6	14	46	36	7	-23	44	8	30	29	36	33	24	24	43	58	100	29	51	40	34	35	38	41
29	A1134N12	27	4	21	31	2	22	6	19	32	-10	25	5	-15	54	50	-5	13	19	3	12	17	31	39	-9	11	12	32	29	100	9	1	8	17	35	1
30	A1140N13	7	60	4	20	13	37	41	54	28	17	27	15	10	26	31	24	-42	43	12	42	38	9	47	49	16	53	52	51	9	100	38	62	23	44	63
31	A1145N15	29	45	2	34	44	34	34	56	38	33	15	23	13	21	13	31	-14	40	39	33	32	2	28	41	35	53	58	40	1	38	100	57	22	32	48
32	A1146N16	20	51	-12	38	4	30	18	54	16	8	21	36	-2	40	37	15	-20	53	22	32	56	27	65	53	27	58	47	34	8	62	57	100	28	43	48
33	A1148N17	20	27	2	15	-12	25	-6	30	36	3	31	-17	11	27	30	-7	-27	19	0	2	15	2	35	36	7	30	34	35	17	23	22	28	100	23	34
34	A1150U23	23	33	11	39	19	38	23	43	33	19	4	29	0	27	50	30	-19	36	9	19	33	45	49	31	21	36	38	38	35	44	32	43	23	100	40
35	A1151U24	23	52	10	48	14	44	43	55	40	37	31	42	-5	31	38	25	-39	54	18	50	28	4	33	52	31	61	57	41	1	63	48	48	34	40	100

Appendix D: Exact Factor 1 Scores in Z-Scores and T-Score Units: Comprehensive

Factor 1

Statement	No.	Z-Score	T-Score
The amount of capital and the availability of capital	1	0.61	56
A smaller operating margin related to EHR (electronic	2	0.08	51
Monetary incentive alone, such as pay-for-performance	3	-0.55	45
Fear of loss of professional autonomy adds resistance	4	1.32	63
Financial incentives can clearly modify EHR adoption	5	0.44	54
Uncertainty about return on investment is a major	6	0.1	51
Entering data into the computer during conversion of	7	0.47	55
Physicians find lack of time to acquire knowledge about	8	1.44	64
My office was/is able to estimate in close approximation	9	-1.41	36
I believe that all stakeholders' interested in promotion	10	-0.45	46
The goals of EHR implementation are to enhance health	11	-1.29	37
Using EMR enables me to complete patient encounter	12	-1.31	37
EHR software leads to excessive use of guidelines, the	13	1.42	64
A standalone EHR is not going to solve the issue of	14	-0.47	45
The ability to interface with hospitals is the biggest	15	0.22	52
My practice is aware of the needs of techno-phobic	16	-0.1	49
Lack of uniform data standards for the industry makes	17	-0.11	49
The most common reason for failure of implementation	18	0.07	51
A physician's own practice group as an organization in	19	-0.51	45

Statement	No.	Z-Score	T-Score
A successful EHR implementation requires a project	20	1.05	61
I find it easy to get EMR to do what I need it to do i	21	-0.89	41
It has been easy to tailor the system to how my practice	22	-0.62	44
There is a positive impact on the quality of	23	-1.35	37
Information and support from physicians who are	24	-1.29	37
The way the system is designed is (maybe) inconsistent	25	0.67	57
There is a need for a buy-in by staff to make them	26	-0.25	47
The CMS pay-for-performance demonstration appear to	27	-0.27	47
Organizational factors such as a culture of innovation	28	-0.03	50
Loss of long-term productivity is a major concern	29	1.11	61
Confidentiality and security add more costs to a	30	0.85	58
Loss of short-term productivity is a major concern	31	1.68	67
Using the EHR system in my practice has (will) increase	32	-1.15	38
Timely record conversion and maintenance in an EHR	33	-1.14	39
Physicians should not be spending their time dealing	34	1.76	68
Using the system requires a lot of extra effort in my	35	1.57	66
The process of preparing and submitting patient	36	-1.09	39
Capacity within my practice to select, install, and	37	2.01	70
Finding a CCHIT certified EHR is (has been) a concern	38	0.26	53
I am aware that an EHR technology requires physicians	39	0.29	53
MY staff and I understood that a team approach would	40	-0.65	43

Statement	No.	Z-Score	T-Score
It is easy for me to become skillful in the use of EHR	41	-1.25	38
I can use the system easily while I perform a medical	42	-0.64	44
Learning to operate the system was (will be) easy for	43	-1.74	33
I like to experiment with new information technologies	44	-1.74	33
Top management's response to training for EHR has	45	0.45	54
I may not/did not receive essential guidance or	46	0.85	58
EHR systems may help laypersons and subordinate	47	-0.39	46
Using the EHR may decrease my professional discretion	48	0.78	58
I have concerns if my standalone EHR system becomes	49	0.11	51
Using EHR may increase monitoring and reviewing of	50	1.06	61

Note. The output from PQMethod 2.20 provided truncated statements; for completed statements, see Appendix B.

Appendix E: Exact Factor 2 Scores in Z-Score and T-Score Units: Comprehensive

Factor 2

Statement	No.	Z-Score	T-Score
The amount of capital and the availability of capital	1	1.5	65
A smaller operating margin related to EHR (electronic	2	-0.29	47
Monetary incentive alone, such as pay-for-performance	3	-1.64	34
Fear of loss of professional autonomy adds resistance	4	-1.13	39
Financial incentives can clearly modify EHR adoption	5	-0.45	46
Uncertainty about return on investment is a major barrier	6	0.3	53
Entering data into the computer during conversion of	7	0.82	58
Physicians find lack of time to acquire knowledge about	8	1.13	61
My office was/is able to estimate in close approximation	9	-0.62	44
I believe that all stakeholders' interested in promotion	10	-0.93	41
The goals of EHR implementation are to enhance health	11	-0.47	45
Using EMR enables me to complete patient encounter	12	-0.96	40
EHR software leads to excessive use of guidelines, the	13	-1.5	35
A standalone EHR is not going to solve the issue of	14	0.78	58
The ability to interface with hospitals is the biggest	15	-1.94	31
My practice is aware of the needs of techno-phobic	16	-0.6	44
Lack of uniform data standards for the industry makes	17	1.5	65
The most common reason for failure of implementation	18	-0.03	50
A physician's own practice group as an organization in	19	0.16	52

A successful EHR implementation requires a project team	20	0.32	53
I find it easy to get EMR to do what I need it to do	21	-0.88	41
It has been easy to tailor the system to how my practice	22	-0.81	42
There is a positive impact on the quality of	23	-0.82	42
Information and support from physicians who are already	24	0.48	55
The way the system is designed is (maybe) inconsistent	25	0.18	52
There is a need for a buy-in by staff to make them willing	26	0.91	59
The CMS pay-for-performance demonstration appear to	27	-1.21	38
Organizational factors such as a culture of innovation	28	1.15	62
Loss of long-term productivity is a major concern during	29	1.45	64
Confidentiality and security add more costs to a	30	0.58	56
Loss of short-term productivity is a major concern during	31	1.02	60
Using the EHR system in my practice has (will) increase	32	-0.73	43
Timely record conversion and maintenance in an EHR	33	0.88	59
Physicians should not be spending their time dealing	34	0.54	55
Using the system requires a lot of extra effort in my	35	-0.54	45
The process of preparing and submitting patient	36	-0.26	47
Capacity within my practice to select, install, and	37	-0.17	48
Finding a CCHIT certified EHR is (has been) a concern	38	0.45	55
I am aware that an EHR technology requires physicians	39	-0.16	48
MY staff and I understood that a team approach would	40	1.07	61
It is easy for me to become skillful in the use of EHR	41	1.59	66

I can use the system easily while I perform a medical	42	-1.23	38
Learning to operate the system was (will be) easy for	43	1.05	60
I like to experiment with new information technologies	44	2.11	71
Top management's response to training for EHR has been	45	0.62	56
I may not/did not receive essential guidance or	46	-0.88	41
EHR systems may help laypersons and subordinate	47	-1.59	34
Using the EHR may decrease my professional discretion	48	-1.46	35
I have concerns if my standalone EHR system becomes	49	0.67	57
Using EHR may increase monitoring and reviewing of	50	0.04	50

Note. The output from PQMethod v. 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix F: Exact Factor 3 Scores in Z-Score and T-Score Units: Comprehensive

Factor 3

Statement	No.		
The amount of capital and the availability of capital	1	-1.49	35
A smaller operating margin related to EHR (electronic	2	1.13	61
Monetary incentive alone, such as pay-for-performance	3	2.29	73
Fear of loss of professional autonomy adds resistance	4	-0.68	43
Financial incentives can clearly modify EHR adoption	5	-0.21	48
Uncertainty about return on investment is a major	6	0.4	54
Entering data into the computer during conversion of	7	1.52	65
Physicians find lack of time to acquire knowledge about	8	-0.45	45
My office was/is able to estimate in close approximation	9	0.76	58
I believe that all stakeholders' interested in promotion	10	-0.55	45
The goals of EHR implementation are to enhance health	11	0.6	56
Using EMR enables me to complete patient encounter	12	-1.98	30
EHR software leads to excessive use of guidelines, the	13	-0.21	48
A standalone EHR is not going to solve the issue of	14	1.18	62
The ability to interface with hospitals is the biggest	15	-0.59	44
My practice is aware of the needs of techno-phobic	16	0.57	56
Lack of uniform data standards for the industry makes	17	0.48	55
The most common reason for failure of implementation	18	0.23	52
A physician's own practice group as an organization in	19	1.06	61

A successful EHR implementation requires a project	20	0.44	54
I find it easy to get EMR to do what I need it to do i	21	-0.9	41
It has been easy to tailor the system to how my practice	22	-1.11	39
There is a positive impact on the quality of	23	-0.72	43
Information and support from physicians who are	24	1.58	66
The way the system is designed is (maybe) inconsistent	25	-0.48	45
There is a need for a buy-in by staff to make them	26	0.69	57
The CMS pay-for-performance demonstration appear to	27	0.85	58
Organizational factors such as a culture of innovation	28	1.35	63
Loss of long-term productivity is a major concern	29	-1.09	39
Confidentiality and security add more costs to a	30	0.41	54
Loss of short-term productivity is a major concern	31	-0.33	47
Using the EHR system in my practice has (will) increase	32	-1.31	37
Timely record conversion and maintenance in an EHR	33	0.84	58
Physicians should not be spending their time dealing	34	-1.04	40
Using the system requires a lot of extra effort in my	35	1.04	60
The process of preparing and submitting patient	36	-0.3	47
Capacity within my practice to select, install, and	37	-0.77	42
Finding a CCHIT certified EHR is (has been) a concern	38	0.49	55
I am aware that an EHR technology requires physicians	39	1.08	61
MY staff and I understood that a team approach would	40	1.4	64
It is easy for me to become skillful in the use of EHR	41	-1.97	30

I can use the system easily while I perform a medical	42	-1.48	35
Learning to operate the system was (will be) easy for	43	-1.47	35
I like to experiment with new information technologies	44	-0.56	44
Top management's response to training for EHR has	45	-0.92	41
I may not/did not receive essential guidance or	46	-0.48	45
EHR systems may help laypersons and subordinate	47	0.29	53
Using the EHR may decrease my professional discretion	48	0.23	52
I have concerns if my standalone EHR system becomes	49	0.23	52
Using EHR may increase monitoring and reviewing of	50	-0.04	50

Note. The output from PQMethod 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix G: Factor Arrays: Comprehensive

Factor Q-Sort Values for Each Statement

No.	Statement	Factor Arrays 1	2	3
1	The amount of capital and the availability of capital needed	2	4	-3
2	A smaller operating margin related to EHR (electronic health	0	-1	5
3	Monetary incentive alone, such as pay-for-performance and	-1	-5	3
4	Fear of loss of professional autonomy adds resistance to adopt	3	-2	-2
5	Financial incentives can clearly modify EHR adoption	2	-2	-1
6	Uncertainty about return on investment is a major barrier.	1	1	2
7	Entering data into the computer during conversion of paper	3	2	5
8	Physicians find lack of time to acquire knowledge about the	5	4	1
9	My office was/is able to estimate in close approximation the	-2	-2	3
10	I believe that all stakeholders' interested in promoting EHR	-2	-4	-3
11	The goals of EHR implementation are to enhance Healthcare	-4	-2	0
12	Using EMR enables me to complete patient encounter more	-5	-3	-5
13	EHR software leads to excessive use of guidelines, therefore	3	-3	-2
14	A standalone EHR is not going to solve the issue of	-1	0	2
15	The ability to interface with hospitals is the biggest advantage	-1	-5	-1
16	My practice is aware of the needs of techno-phobic employee	-1	-1	2
17	Lack of uniform data standards for the industry makes	1	3	1
18	The most common reason for failure of implementation is	0	-1	0

19	A physician's own practice group as an organization influence	-1	0	3
20	A successful EHR implementation requires a project team	3	1	4
21	I find it easy to get EMR to do what I need it to do in my	-4	-4	-3
22	It has been easy to tailor the system to how my practice	-3	-2	-3
23	There is a positive impact on the quality of communication	-5	-1	-3
24	Information and support from physicians who are already	-2	1	3
25	The way the system is designed is (maybe) inconsistent with	2	0	-2
26	There is a need for a buy-in by staff to make them willing	0	3	1
27	The CMS pay-for-performance demonstration appear to have	-1	-3	2
28	Organizational factors such as a culture of innovation and	2	5	3
29	Loss of long-term productivity is a major concern during the	4	5	0
30	Confidentiality and security add more costs to a	3	3	2
31	Loss of short-term productivity is a major concern during the	5	5	1
32	Using the EHR system in my practice has (will) increased my	-5	-3	-5
33	Timely record conversion and maintenance in an EHR	-2	2	1
34	Physicians should not be spending their time dealing directly	4	3	-4
35	Using the system requires a lot of extra effort in my practice	4	0	4
36	The process of preparing and submitting patient evaluations	-3	-1	0
37	Capacity within my practice to select, install, and contract	5	1	-1
38	Finding a CCHIT certified EHR is (has been) a concern as the	1	1	-1
39	I am aware that an EHR technology requires physicians and	1	0	4
40	MY staff and I understood that a team approach would best se	0	2	5

41	It is easy for me to become skillful in the use of EHR	-3	3	-5
42	I can use the system easily while I perform a medical	-3	-5	-4
43	Learning to operate the system was (will be) easy for me.	-4	1	-4
44	I like to experiment with new information technologies.	-3	4	-2
45	Top management's response to training for EHR has been	0	2	-2
46	I may not/did not receive essential guidance or explanation	0	-1	-1
47	EHR systems may help laypersons and subordinate	-2	-3	0
48	Using the EHR may decrease my professional discretion over	1	-4	0
49	I have concerns if my standalone EHR system becomes	1	2	-1
50	Using EHR may increase monitoring and reviewing of	2	0	1

Appendix H: Difference Scores Between Factors 1 and 2: Comprehensive

Descending Array of Differences Between Factors 1 and 2

Statement	No.	Type1	Type2	Diff
EHR software leads to excessive use of guidelines,	13	0.961	-1.155	2.116
Fear of loss of professional autonomy adds resistance to	4	0.909	-0.902	1.811
Using the EHR may decrease my professional discretion	48	0.475	-1.308	1.783
Using the system requires a lot of extra effort in my	35	1.591	-0.001	1.593
Financial incentives can clearly modify EHR adoption	5	0.569	-0.985	1.554
The ability to interface with hospitals is the biggest	15	-0.353	-1.852	1.499
Monetary incentive alone, such as pay-for-performance	3	-0.346	-1.612	1.266
Capacity within my practice to select, install, and	37	1.633	0.455	1.179
The CMS pay-for-performance demonstration appear to	27	-0.285	-1.188	0.903
Physicians should not be spending their time dealing	34	1.5	0.871	0.629
Using EHR may increase monitoring and reviewing of	50	0.753	0.141	0.613
I may not/did not receive essential guidance or	46	0.205	-0.347	0.552
A smaller operating margin related to EHR (electronic	2	0.203	-0.288	0.49
A successful EHR implementation requires a project	20	1.017	0.568	0.449
I can use the system easily while I perform a medical	42	-1.085	-1.521	0.436
I believe that all stakeholders’ interested in promoting	10	-0.828	-1.261	0.432
My practice is aware of the needs of techno-phobic	16	-0.106	-0.529	0.423
EHR systems may help laypersons and subordinate	47	-0.843	-1.21	0.367
The most common reason for failure of implementation	18	0.002	-0.33	0.332
The way the system is designed is (maybe) inconsistent	25	0.5	0.254	0.246
Entering data into the computer during conversion of	7	0.991	0.765	0.226
Confidentiality and security add more costs to a	30	1.039	0.824	0.215
Physicians find lack of time to acquire knowledge about	8	1.616	1.49	0.126
It has been easy to tailor the system to how my practice	22	-1.001	-1.109	0.108

I am aware that an EHR technology requires physicians	39	0.45	0.362	0.087
I find it easy to get EMR to do what I need it to do in my	21	-1.333	-1.271	-0.062
Uncertainty about return on investment is a major	6	0.361	0.44	-0.08
Loss of short-term productivity is a major concern	31	1.684	1.776	-0.092
Finding a CCHIT certified EHR is (has been) a concern	38	0.314	0.521	-0.206
My office was/is able to estimate in close approximation	9	-0.986	-0.747	-0.24
Loss of long-term productivity is a major concern during	29	1.395	1.648	-0.253
A physician's own practice group as an organization	19	-0.187	0.163	-0.35
I have concerns if my standalone EHR system becomes	49	0.292	0.644	-0.352
The goals of EHR implementation are to enhance health	11	-1.301	-0.876	-0.425
Using the EHR system in my practice has (will)	32	-1.576	-1.15	-0.426
A standalone EHR is not going to solve the issue of	14	-0.138	0.393	-0.531
Top management’s response to training for EHR has	45	0.129	0.683	-0.554
The amount of capital and the availability of capital	1	0.794	1.388	-0.594
MY staff and I understood that a team approach would	40	0.053	0.666	-0.614
There is a need for a buy-in by staff to make them	26	0.213	0.933	-0.72
The process of preparing and submitting patient	36	-1.209	-0.461	-0.749
Using EMR enables me to complete patient encounter	12	-2.008	-1.239	-0.769
Lack of uniform data standards for the industry makes	17	0.32	1.113	-0.793
Organizational factors such as a culture of innovation	28	0.742	1.55	-0.808
Timely record conversion and maintenance in an EHR	33	-0.499	0.638	-1.137
There is a positive impact on the quality of	23	-1.823	-0.467	-1.356
Information and support from physicians who are	24	-0.834	0.573	-1.407
Learning to operate the system was (will be) easy for	43	-1.569	0.488	-2.058
It is easy for me to become skillful in the use of EHR	41	-1.208	1.094	-2.302
I like to experiment with new information technologies.	44	-1.191	1.368	-2.56

Appendix I: Difference Scores Between Factors 1 and 3: Comprehensive

Descending Array of Differences Between Factors 1 and 3

Statement	No.	Type 1	Type 3	Diff
Physicians should not be spending their time dealing direct	34	1.5	-1.284	2.784
Capacity within my practice to select, install, and contract	37	1.633	-0.436	2.069
The amount of capital and the availability of capital needed	1	0.794	-0.884	1.679
Fear of loss of professional autonomy adds resistance to	4	0.909	-0.701	1.61
EHR software leads to excessive use of guidelines, therefore	13	0.961	-0.633	1.594
Loss of long-term productivity is a major concern during the	29	1.395	-0.157	1.552
Loss of short-term productivity is a major concern during the	31	1.684	0.362	1.322
Physicians find lack of time to acquire knowledge about the	8	1.616	0.33	1.286
The way the system is designed is (maybe) inconsistent with	25	0.5	-0.612	1.112
Financial incentives can clearly modify EHR adoption	5	0.569	-0.163	0.732
Top management’s response to training for EHR has been	45	0.129	-0.532	0.661
It is easy for me to become skillful in the use of EHR tech	41	-1.208	-1.799	0.591
I may not/did not receive essential guidance or explanation	46	0.205	-0.365	0.569
I have concerns if my standalone EHR system becomes	49	0.292	-0.271	0.563
I can use the system easily while I perform a medical	42	-1.085	-1.631	0.545
Using the EHR may decrease my professional discretion over	48	0.475	-0.034	0.508
Finding a CCHIT certified EHR is (has been) a concern as	38	0.314	-0.179	0.494
Confidentiality and security add more costs to a	30	1.039	0.675	0.364
Using EMR enables me to complete patient encounter more	12	-2.008	-2.288	0.28
It has been easy to tailor the system to how my practice	22	-1.001	-1.273	0.272
Using EHR may increase monitoring and reviewing of	50	0.753	0.505	0.248
Using the system requires a lot of extra effort in my practice	35	1.591	1.391	0.2
Using the EHR system in my practice has (will) increased	32	-1.576	-1.716	0.14
I believe that all stakeholders’ interested in promoting EHR	10	-0.828	-0.923	0.095
The ability to interface with hospitals is the biggest	15	-0.353	-0.326	-0.026

The most common reason for failure of implementation is	18	0.002	0.11	-0.108
Learning to operate the system was (will be) easy for me.	43	-1.569	-1.458	-0.111
There is a need for a buy-in by staff to make them willing	26	0.213	0.342	-0.13
Lack of uniform data standards for the industry makes	17	0.32	0.517	-0.197
Uncertainty about return on investment is a major barrier.	6	0.361	0.593	-0.232
I like to experiment with new information technologies.	44	-1.191	-0.806	-0.385
Organizational factors such as a culture of innovation and	28	0.742	1.13	-0.389
I find it easy to get EMR to do what I need it to do in my	21	-1.333	-0.942	-0.391
A successful EHR implementation requires a project team	20	1.017	1.43	-0.413
My practice is aware of the needs of techno-phobic	16	-0.106	0.569	-0.675
A standalone EHR is not going to solve the issue of	14	-0.138	0.557	-0.695
Entering data into the computer during conversion of paper	7	0.991	1.71	-0.719
EHR systems may help laypersons and subordinate	47	-0.843	-0.08	-0.763
There is a positive impact on the quality of communication	23	-1.823	-0.963	-0.86
Timely record conversion and maintenance in an EHR	33	-0.499	0.453	-0.952
I am aware that an EHR technology requires physicians and	39	0.45	1.418	-0.968
The CMS pay-for-performance demonstration appear to have	27	-0.285	0.715	-1
A physician's own practice group as an organization influence	19	-0.187	0.88	-1.067
The process of preparing and submitting patient evaluations	36	-1.209	-0.064	-1.145
A smaller operating margin related to EHR (electronic health	2	0.203	1.462	-1.259
The goals of EHR implementation are to enhance Healthcare	11	-1.301	0.255	-1.556
Monetary incentive alone, such as pay-for-performance and	3	-0.346	1.317	-1.662
MY staff and I understood that a team approach would best	40	0.053	1.734	-1.681
My office was/is able to estimate in close approximation the	9	-0.986	0.722	-1.708
Information and support from physicians who are already	24	-0.834	1.342	-2.176

Appendix J: Difference Scores Between Factors 2 and 3: Comprehensive

Descending Array of Differences Between Factors 2 and 3

Statement	No.	Type 2	Type 3	Diff
It is easy for me to become skillful in the use of EHR tech	41	1.094	-1.799	2.893
The amount of capital and the availability of capital need	1	1.388	-0.884	2.273
I like to experiment with new information technologies.	44	1.368	-0.806	2.174
Physicians should not be spending their time dealing	34	0.871	-1.284	2.155
Learning to operate the system was (will be) easy for me.	43	0.488	-1.458	1.947
Loss of long-term productivity is a major concern during	29	1.648	-0.157	1.805
Loss of short-term productivity is a major concern during	31	1.776	0.362	1.414
Top management's response to training for EHR has been	45	0.683	-0.532	1.215
Physicians find lack of time to acquire knowledge about	8	1.49	0.33	1.16
Using EMR enables me to complete patient encounter	12	-1.239	-2.288	1.049
I have concerns if my standalone EHR system becomes	49	0.644	-0.271	0.915
Capacity within my practice to select, install, and contract	37	0.455	-0.436	0.891
The way the system is designed is (maybe) inconsistent	25	0.254	-0.612	0.866
Finding a CCHIT certified EHR is (has been) a concern as	38	0.521	-0.179	0.7
Lack of uniform data standards for the industry makes	17	1.113	0.517	0.596
There is a need for a buy-in by staff to make them willing	26	0.933	0.342	0.59
Using the EHR system in my practice has (will) increased	32	-1.15	-1.716	0.566
There is a positive impact on the quality of communicate	23	-0.467	-0.963	0.495
Organizational factors such as a culture of innovation and	28	1.55	1.13	0.42
Timely record conversion and maintenance in an EHR	33	0.638	0.453	0.185
It has been easy to tailor the system to how my practice	22	-1.109	-1.273	0.163
Confidentiality and security add more costs to a	30	0.824	0.675	0.148
I can use the system easily while I perform a medical	42	-1.521	-1.631	0.109
I may not/did not receive essential guidance or	46	-0.347	-0.365	0.018
Uncertainty about return on investment is a major barrier.	6	0.44	0.593	-0.153

A standalone EHR is not going to solve the issue of	14	0.393	0.557	-0.164
Fear of loss of professional autonomy adds resistance to	4	-0.902	-0.701	-0.201
I find it easy to get EMR to do what I need it to do in my p	21	-1.271	-0.942	-0.329
I believe that all stakeholders' interested in promoting	10	-1.261	-0.923	-0.337
Using EHR may increase monitoring and reviewing of	50	0.141	0.505	-0.364
The process of preparing and submitting patient	36	-0.461	-0.064	-0.397
The most common reason for failure of implementation is	18	-0.33	0.11	-0.44
EHR software leads to excessive use of guidelines,	13	-1.155	-0.633	-0.522
A physician's own practice group as an organization	19	0.163	0.88	-0.717
Information and support from physicians who are already	24	0.573	1.342	-0.769
Financial incentives can clearly modify EHR adoption	5	-0.985	-0.163	-0.822
A successful EHR implementation requires a project team	20	0.568	1.43	-0.862
Entering data into the computer during conversion of	7	0.765	1.71	-0.945
I am aware that an EHR technology requires physicians	39	0.362	1.418	-1.056
MY staff and I understood that a team approach would	40	0.666	1.734	-1.067
My practice is aware of the needs of techno-phobic	16	-0.529	0.569	-1.098
EHR systems may help laypersons and subordinate	47	-1.21	-0.08	-1.13
The goals of EHR implementation are to enhance health c	11	-0.876	0.255	-1.132
Using the EHR may decrease my professional discretion	48	-1.308	-0.034	-1.274
Using the system requires a lot of extra effort in my	35	-0.001	1.391	-1.393
My office was/is able to estimate in close approximation	9	-0.747	0.722	-1.469
The ability to interface with hospitals is the biggest	15	-1.852	-0.326	-1.526
A smaller operating margin related to EHR (electronic	2	-0.288	1.462	-1.749
The CMS pay-for-performance demonstration appear to	27	-1.188	0.715	-1.903
Monetary incentive alone, such as pay-for-performance	3	-1.612	1.317	-2.929

Appendix K: Correlational Matrix for Q-Sort-Nonuser of an Electronic Health Record System

Correlational Martix Between Sorts for Non-Users of EHR Technology Systems																
SORTS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	A1114N1	100	28	9	-3	15	28	16	12	13	8	3	12	39	22	0
2	A1116N2	28	100	23	-4	29	25	23	38	45	30	12	42	33	32	2
3	A1120N3	9	23	100	15	49	30	14	35	31	29	17	38	32	56	15
4	A1123N4	-3	-4	15	100	27	-7	23	7	24	36	31	9	2	27	2
5	A1124N5	15	29	49	27	100	41	20	42	38	33	39	47	28	65	35
6	A1126N6	28	25	30	-7	41	100	9	51	40	24	-9	49	41	53	36
7	A1128N7	16	23	14	23	20	9	100	26	23	24	11	16	35	27	7
8	A1130N8	12	38	35	7	42	51	26	100	59	43	12	53	53	58	30
9	A1131N9	13	45	31	24	38	40	23	59	100	58	32	52	58	47	34
10	A1132N10	8	30	29	36	33	24	24	43	58	100	29	51	40	34	35
11	A1134N12	3	12	17	31	39	-9	11	12	32	29	100	9	1	8	17
12	A1140N13	12	42	38	9	47	49	16	53	52	51	9	100	38	62	23
13	A1145N15	39	33	32	2	28	41	35	53	58	40	1	38	100	57	22
14	A1146N16	22	32	56	27	65	53	27	58	47	34	8	62	57	100	28
15	A1148N17	0	2	15	2	35	36	7	30	34	35	17	23	22	28	100

Appendix L: Unrotated Factor Matrix for Nonusers of an Electronic Health Record System

Unrotated Factor Matrix - Non Users of EHR System									
	Factors	1	2	3	4	5	6	7	8
	SORTS								
1	A1114N1	0.3053	-0.3874	0.4809	0.1787	0.1367	0.565	-0.3086	-0.0666
2	A1116N2	0.5327	-0.2033	0.3657	-0.0821	0.5129	-0.2208	0.1809	-0.1963
3	A1120N3	0.5815	0.0736	-0.1734	0.5002	0.0627	-0.122	0.0761	0.4297
4	A1123N4	0.2639	0.6973	0.1991	0.1919	-0.3076	-0.0774	-0.3754	-0.1978
5	A1124N5	0.6981	0.2298	-0.2188	0.3788	0.1424	0.1866	0.1604	-0.1792
6	A1126N6	0.6301	-0.4315	-0.3039	0.0197	-0.0809	0.1461	-0.103	-0.2379
7	A1128N7	0.3848	0.1097	0.5554	0.0215	-0.4489	0.0161	0.5139	-0.1545
8	A1130N8	0.754	-0.1495	-0.076	-0.1623	-0.0514	-0.1616	0.1153	0.0694
9	A1131N9	0.7683	0.1119	0.082	-0.3664	0.0927	-0.0811	-0.1065	0.1676
10	A1132N10	0.6526	0.3221	0.0648	-0.3828	-0.0372	-0.114	-0.246	0.0052
11	A1134N12	0.2865	0.6818	0.0835	-0.0449	0.4285	0.3241	0.1339	0.1209
12	A1140N13	0.7399	-0.1012	-0.1553	-0.0176	0.126	-0.3142	-0.094	-0.2546
13	A1145N15	0.6929	-0.3055	0.2709	-0.1172	-0.2209	0.0849	-0.0722	0.3864
14	A1146N16	0.8115	-0.0813	-0.1139	0.3568	-0.1681	-0.067	-0.0435	-0.0152
15	A1148N17	0.4389	0.0975	-0.49	-0.3785	-0.1838	0.4594	0.182	-0.0556
	Eigenvalues	5.3628	1.6572	1.2576	1.0637	0.9315	0.9174	0.7273	0.6443
	% expl.Var.	36	11	8	7	6	6	5	4

Appendix M: Exact Factor 1 Scores in Z-Score and T-Score Units for Nonusers

Statement	No.	Z-Score	T-Score
There is a positive impact on the quality of	23	-1.84	32
Using the EHR system in my practice has (will)	32	-1.84	32
Information and support from physicians who are	24	-1.79	32
Using EMR enables me to complete patient encounter	12	-1.7	33
The process of preparing and submitting patient	36	-1.38	36
The goals of EHR implementation are to enhance	11	-1.26	37
I like to experiment with new information technology	44	-1.16	38
I can use the system easily while I perform a medical	42	-1.13	39
I find it easy to get EMR to do what I need it to do i	21	-0.91	41
Monetary incentive alone, such as pay-for-performance	3	-0.83	42
Learning to operate the system was (will be) easy for	43	-0.82	42
EHR systems may help laypersons and subordinate	47	-0.79	42
It has been easy to tailor the system to how my practice	22	-0.76	42
The CMS pay-for-performance demonstration appear to	27	-0.72	43
A standalone EHR is not going to solve the issue of	14	-0.67	43
Organizational factors such as a culture of innovation	28	-0.67	43
Timely record conversion and maintenance in an EHR	33	-0.54	45
The most common reason for failure of implement	18	-0.46	45
I believe that all stakeholders' interested in promotion	10	-0.43	46
A physician's own practice group as an organization in	19	-0.3	47

A smaller operating margin related to EHR (electronic	2	-0.2	48
My office was/is able to estimate in close approx.	9	-0.15	48
It is easy for me to become skillful in the use of EHR	41	-0.07	49
MY staff and I understood that a team approach would	40	-0.01	50
There is a need for a buy-in by staff to make them will	26	0	50
The way the system is designed is (maybe) inconsistent	25	0.09	51
Using EHR may increase monitoring and reviewing of	50	0.12	51
Using the EHR may decrease my professional discretion	48	0.22	52
I may not/did not receive essential guidance or	46	0.23	52
Financial incentives can clearly modify EHR adoption	5	0.27	53
Entering data into the computer during conversion of	7	0.27	53
Top management's response to training for EHR has	45	0.29	53
I have concerns if my standalone EHR system becomes	49	0.3	53
My practice is aware of the needs of techno-phobic	16	0.35	54
I am aware that an EHR technology requires physicians	39	0.53	55
The ability to interface with hospitals is the biggest	15	0.58	56
Finding a CCHIT certified EHR is (has been) a concern	38	0.61	56
Loss of short-term productivity is a major concern	31	0.68	57
Uncertainty about return on investment is a major	6	0.88	59
Lack of uniform data standards for the industry makes	17	0.91	59
Physicians find lack of time to acquire knowledge about	8	1.05	61
A successful EHR implementation requires a project tea	20	1.09	61

Fear of loss of professional autonomy adds resistance	4	1.12	61
The amount of capital and the availability of capital	1	1.19	62
EHR software leads to excessive use of guidelines, the	13	1.45	65
Confidentiality and security add more costs to a	30	1.47	65
Physicians should not be spending their time dealing	34	1.53	65
Loss of long-term productivity is a major concern during	29	1.66	67
Using the system requires a lot of extra effort in my	35	1.72	67
Capacity within my practice to select, install, and	37	1.83	68

Note. The output from PQMethod v. 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix N: Exact Factor 2 Scores in Z-Score and T-Score Units for Nonusers

Statement	No.	Z-Score	T-Score
It is easy for me to become skillful in the use of EHR	41	-2.70	23
Learning to operate the system was (will be) easy for	43	-2.45	26
The amount of capital and the availability of capital	1	-1.53	35
Loss of long-term productivity is a major concern	29	-1.22	38
My office was/is able to estimate in close	9	-1.12	39
I can use the system easily while I perform a medical	42	-1.1	39
The ability to interface with hospitals is the biggest	15	-0.97	40
Using EMR enables me to complete patient encounter	12	-0.96	40
I find it easy to get EMR to do what I need it to do i	21	-0.82	42
I believe that all stakeholders' interested in promotion	10	-0.77	42
Uncertainty about return on investment is a major	6	-0.69	43
Lack of uniform data standards for the industry makes	17	-0.69	43
I like to experiment with new information technologies	44	-0.68	43
The way the system is designed is (maybe) inconsistent	25	-0.63	44
Using the EHR system in my practice has (will)	32	-0.57	44
Timely record conversion and maintenance in an EHR	33	-0.36	46
Fear of loss of professional autonomy adds resistance	4	-0.32	47
It has been easy to tailor the system to how my practice	22	-0.29	47
Top management's response to training for EHR has	45	-0.23	48
MY staff and I understood that a team approach would	40	-0.19	48

Using the EHR may decrease my professional	48	-0.15	49
My practice is aware of the needs of techno-phobic	16	-0.14	49
There is a need for a buy-in by staff to make them will	26	-0.13	49
The goals of EHR implementation are to enhance	11	-0.02	50
EHR software leads to excessive use of guidelines, the	13	-0.01	50
There is a positive impact on the quality of	23	0	50
A physician's own practice group as an organization in	19	0.04	50
The process of preparing and submitting patient	36	0.05	51
I have concerns if my standalone EHR system becomes	49	0.05	50
Using the system requires a lot of extra effort in my	35	0.15	52
EHR systems may help laypersons and subordinate	47	0.2	52
Capacity within my practice to select, install, and	37	0.22	52
Confidentiality and security add more costs to a	30	0.28	53
I may not/did not receive essential guidance or	46	0.39	54
Physicians should not be spending their time dealing	34	0.45	54
Using EHR may increase monitoring and reviewing of	50	0.54	55
Finding a CCHIT certified EHR is (has been) a concern	38	0.58	56
A standalone EHR is not going to solve the issue of	14	0.63	56
A successful EHR implementation requires a project	20	0.66	57
I am aware that an EHR technology requires physicians	39	0.69	57
Financial incentives can clearly modify EHR adoption	5	0.76	58
Physicians find lack of time to acquire knowledge	8	0.83	58

The CMS pay-for-performance demonstration appear to	27	1.12	61
A smaller operating margin related to EHR (electronic	2	1.13	61
Entering data into the computer during conversion of	7	1.14	61
The most common reason for failure of implement	18	1.24	62
Monetary incentive alone, such as pay-for-performance	3	1.48	65
Organizational factors such as a culture of innovation	28	1.96	70
Information and support from physicians who are	24	2.07	71
Loss of short-term productivity is a major concern	31	2.07	71

Note. The output from PQMethod 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix O: Exact Factor 3 Scores in Z-Score and T-score Units for Nonusers

Statement	No.	Z-Score	T-Score
The ability to interface with hospitals is the biggest	15	-2.51	25
EHR software leads to excessive use of guidelines, the	13	-2.06	29
Using the EHR may decrease my professional discretion	48	-1.84	32
Using the system requires a lot of extra effort in my	35	-1.72	33
Monetary incentive alone, such as pay-for-performance	3	-1.7	33
My practice is aware of the needs of techno-phobic employee	16	-1.41	36
My office was/is able to estimate in close approximation	9	-1.29	37
EHR systems may help laypersons and subordinate	47	-1.16	38
Fear of loss of professional autonomy adds resistance	4	-1.01	40
Finding a CCHIT certified EHR is (has been) a concern	38	-0.8	42
There is a positive impact on the quality of communication	23	-0.69	43
The CMS pay-for-performance demonstration appear to ha	27	-0.65	44
A physician's own practice group as an organization in	19	-0.58	44
I believe that all stakeholders' interested in promotion	10	-0.48	45
Uncertainty about return on investment is a major barrier	6	-0.43	46
Using EMR enables me to complete patient encounter more	12	-0.34	47
I can use the system easily while I perform a medical	42	-0.25	48
I may not/did not receive essential guidance or explanation	46	-0.24	48
The most common reason for failure of implementation	18	-0.19	48
Confidentiality and security add more costs to a	30	-0.16	48
I am aware that an EHR technology requires physicians	39	-0.06	49
There is a need for a buy-in by staff to make them willing	26	0.05	51
Timely record conversion and maintenance in an EHR	33	0.1	51
The goals of EHR implementation are to enhance health	11	0.12	51
Financial incentives can clearly modify EHR adoption	5	0.14	51

Capacity within my practice to select, install, and co	37	0.17	52
Information and support from physicians who are already	24	0.19	52
The process of preparing and submitting patient evaluation	36	0.22	52
It has been easy to tailor the system to how my practice	22	0.23	52
A successful EHR implementation requires a project team	20	0.26	53
I find it easy to get EMR to do what I need it to do i	21	0.26	53
Learning to operate the system was (will be) easy for	43	0.31	53
A smaller operating margin related to EHR (electronic	2	0.37	54
The way the system is designed is (maybe) inconsistent	25	0.51	55
Using EHR may increase monitoring and reviewing of	50	0.54	55
Using the EHR system in my practice has (will) increase	32	0.58	56
MY staff and I understood that a team approach would b	40	0.58	56
I have concerns if my standalone EHR system becomes	49	0.6	56
Physicians should not be spending their time dealing	34	0.75	57
Lack of uniform data standards for the industry makes	17	0.81	58
A standalone EHR is not going to solve the issue of	14	0.93	59
Entering data into the computer during conversion of	7	0.94	59
Top management’s response to training for EHR has been	45	1.07	61
Loss of short-term productivity is a major concern during	31	1.09	61
I like to experiment with new information technologies	44	1.1	61
It is easy for me to become skillful in the use of EHR	41	1.18	62
Organizational factors such as a culture of innovation	28	1.34	63
Loss of long-term productivity is a major concern during	29	1.43	64
Physicians find lack of time to acquire knowledge about	8	1.81	68
The amount of capital and the availability of capital	1	1.87	69

Note. The output from PQMethod v. 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix P: Factor Arrays for Nonusers of the Electronic Health Record System

Factor Q-Sort Values for Each Statement

		Factor Arrays		
No.	Statement	1	2	3
1	The amount of capital and the availability of capital needed	3	-3	5
2	A smaller operating margin related to EHR (electronic health	1	5	1
3	Monetary incentive alone, such as pay-for-performance and	-2	2	-4
4	Fear of loss of professional autonomy adds resistance to	3	0	-3
5	Financial incentives can clearly modify EHR adoption	2	1	3
6	Uncertainty about return on investment is a major barrier.	1	-3	-2
7	Entering data into the computer during conversion of paper	2	3	3
8	Physicians find lack of time to acquire knowledge about the	5	3	5
9	My office was/is able to estimate in close approximation the	-2	-3	-2
10	I believe that all stakeholders' interested in promoting EHR	-3	-3	-3
11	The goals of EHR implementation are to enhance Healthcare	-3	-1	-1
12	Using EMR enables me to complete patient encounter more	-5	-4	-3
13	EHR software leads to excessive use of guidelines, therefore	3	0	-5
14	A standalone EHR is not going to solve the issue of	-1	2	2
15	The ability to interface with hospitals is the biggest advantage	0	-2	-5
16	My practice is aware of the needs of techno-phobic employees	0	-1	-4
17	Lack of uniform data standards for the industry makes	2	0	2
18	The most common reason for failure of implementation is	-1	4	-1

19	A physician's own practice group as an organization influence	-1	2	-2
20	A successful EHR implementation requires a project team	3	4	0
21	I find it easy to get EMR to do what I need it to do in my	-3	-3	-2
22	It has been easy to tailor the system to how my practice	-2	-2	-1
23	There is a positive impact on the quality of communication	-5	-1	-3
24	Information and support from physicians who are already	-3	5	1
25	The way the system is designed is (maybe) inconsistent with	0	-1	0
26	There is a need for a buy-in by staff to make them willing to	-1	-2	0
27	The CMS pay-for-performance demonstration appear to have	-1	3	-3
28	Organizational factors such as a culture of innovation and	0	3	4
29	Loss of long-term productivity is a major concern during the	3	-4	3
30	Confidentiality and security add more costs to a	4	1	0
31	Loss of short-term productivity is a major concern during the	4	5	4
32	Using the EHR system in my practice has (will) increased my	-5	-4	1
33	Timely record conversion and maintenance in an EHR	-2	-2	2
34	Physicians should not be spending their time dealing directly	5	1	1
35	Using the system requires a lot of extra effort in my practice	4	-1	-4
36	The process of preparing and submitting patient evaluations	-4	0	-1
37	Capacity within my practice to select, install, and contract	5	2	1
38	Finding a CCHIT certified EHR is (has been) a concern as the	2	1	-2
39	I am aware that an EHR technology requires physicians and	2	2	1
40	MY staff and I understood that a team approach would best se	0	-2	2

41	It is easy for me to become skillful in the use of EHR	-1	-5	5
42	I can use the system easily while I perform a medical	-4	-5	-1
43	Learning to operate the system was (will be) easy for me.	-4	-5	3
44	I like to experiment with new information technologies.	-3	0	3
45	Top management’s response to training for EHR has been	1	1	2
46	I may not/did not receive essential guidance or explanation	1	4	0
47	EHR systems may help laypersons and subordinate	-2	1	-2
48	Using the EHR may decrease my professional discretion over	0	-1	-5
49	I have concerns if my standalone EHR system becomes	1	0	3
50	Using EHR may increase monitoring and reviewing of	1	3	0

Appendix Q: Difference Scores Between Factors 1 and 2 for Nonusers

Descending Array of Differences Between Factors 1 and 2

Statement	No.	Type 1	Type 2	Diff
Loss of long-term productivity is a major concern during the	29	1.17	-1.271	2.441
The amount of capital and the availability of capital needed	1	1.102	-1.106	2.209
Using the system requires a lot of extra effort in my practice	35	1.491	-0.325	1.816
Uncertainty about return on investment is a major barrier.	6	0.632	-1.143	1.775
It is easy for me to become skillful in the use of EHR tech	41	-0.487	-1.848	1.36
EHR software leads to excessive use of guidelines, therefore	13	1.233	0.108	1.125
Physicians should not be spending their time dealing	34	1.527	0.47	1.057
Fear of loss of professional autonomy adds resistance to ado	4	1.138	0.108	1.03
Capacity within my practice to select, install, and contract	37	1.746	0.779	0.966
Confidentiality and security add more costs to a	30	1.333	0.398	0.935
Learning to operate the system was (will be) easy for me.	43	-1.355	-2.138	0.783
My office was/is able to estimate in close approximation the	9	-0.506	-1.214	0.708
The ability to interface with hospitals is the biggest	15	-0.05	-0.706	0.656
Using the EHR may decrease my professional discretion	48	0.151	-0.415	0.567
Physicians find lack of time to acquire knowledge about the	8	1.515	0.962	0.553
There is a need for a buy-in by staff to make them willing	26	-0.182	-0.689	0.508
MY staff and I understood that a team approach would best	40	-0.035	-0.527	0.491
I can use the system easily while I perform a medical	42	-1.411	-1.85	0.439
Lack of uniform data standards for the industry makes	17	0.633	0.289	0.344
Timely record conversion and maintenance in an EHR	33	-0.617	-0.923	0.306
My practice is aware of the needs of techno-phobic	16	0.078	-0.197	0.275
The way the system is designed is (maybe) inconsistent with	25	-0.118	-0.38	0.262
Financial incentives can clearly modify EHR adoption	5	0.747	0.491	0.256
Finding a CCHIT certified EHR is (has been) a concern as	38	0.676	0.433	0.243

I believe that all stakeholders' interested in promoting EHR	10	-0.98	-1.033	0.052
A successful EHR implementation requires a project team	20	1.195	1.143	0.051
I am aware that an EHR technology requires physicians and	39	0.687	0.689	-0.003
I have concerns if my standalone EHR system becomes	49	0.23	0.272	-0.042
I find it easy to get EMR to do what I need it to do in my	21	-1.151	-1.087	-0.064
Top management's response to training for EHR has been	45	0.426	0.524	-0.098
It has been easy to tailor the system to how my practice	22	-0.867	-0.762	-0.106
Entering data into the computer during conversion of paper	7	0.644	0.872	-0.227
Using EHR may increase monitoring and reviewing of	50	0.455	0.832	-0.377
Using the EHR system in my practice has (will) increased	32	-1.729	-1.322	-0.407
I may not/did not receive essential guidance or explanation	46	0.243	0.996	-0.754
Organizational factors such as a culture of innovation and	28	0.135	0.943	-0.808
Using EMR enables me to complete patient encounter more	12	-2.076	-1.231	-0.845
The goals of EHR implementation are to enhance health	11	-1.122	-0.237	-0.884
Loss of short-term productivity is a major concern during	31	1.443	2.338	-0.895
A standalone EHR is not going to solve the issue of	14	-0.465	0.526	-0.991
A smaller operating margin related to EHR (electronic	2	0.272	1.288	-1.016
A physician's own practice group as an organization	19	-0.468	0.578	-1.046
I like to experiment with new information technologies.	44	-0.891	0.201	-1.092
The process of preparing and submitting patient evaluations	36	-1.292	-0.163	-1.129
EHR systems may help laypersons and subordinate	47	-0.782	0.525	-1.307
The CMS pay-for-performance demonstration appear to	27	-0.474	0.87	-1.344
The most common reason for failure of implementation is	18	-0.278	1.215	-1.493
Monetary incentive alone, such as pay-for-performance and	3	-0.687	0.814	-1.501
There is a positive impact on the quality of communication	23	-1.846	-0.18	-1.665
Information and support from physicians who are already	24	-1.03	2.084	-3.114

Appendix R: Difference Scores Between Factors 1 and 3 for Nonusers

Descending Array of Differences Between Factors 1 and 3

Statement	No.	Type 1	Type 3	Diff
Physicians should not be spending their time dealing	34	1.5	-1.284	2.784
Capacity within my practice to select, install, and	37	1.633	-0.436	2.069
The amount of capital and the availability of capital	1	0.794	-0.884	1.679
Fear of loss of professional autonomy adds resistance to	4	0.909	-0.701	1.61
EHR software leads to excessive use of guidelines,	13	0.961	-0.633	1.594
Loss of long-term productivity is a major concern during	29	1.395	-0.157	1.552
Loss of short-term productivity is a major concern during	31	1.684	0.362	1.322
Physicians find lack of time to acquire knowledge about	8	1.616	0.33	1.286
The way the system is designed is (maybe) inconsistent	25	0.5	-0.612	1.112
Financial incentives can clearly modify EHR adoption	5	0.569	-0.163	0.732
Top management's response to training for EHR has	45	0.129	-0.532	0.661
It is easy for me to become skillful in the use of EHR tech	41	-1.208	-1.799	0.591
I may not/did not receive essential guidance or explain	46	0.205	-0.365	0.569
I have concerns if my standalone EHR system becomes	49	0.292	-0.271	0.563
I can use the system easily while I perform a medical	42	-1.085	-1.631	0.545
Using the EHR may decrease my professional discretion	48	0.475	-0.034	0.508
Finding a CCHIT certified EHR is (has been) a concern as	38	0.314	-0.179	0.494
Confidentiality and security add more costs to a	30	1.039	0.675	0.364
Using EMR enables me to complete patient encounter	12	-2.008	-2.288	0.28
It has been easy to tailor the system to how my practice	22	-1.001	-1.273	0.272
Using EHR may increase monitoring and reviewing of	50	0.753	0.505	0.248
Using the system requires a lot of extra effort in my	35	1.591	1.391	0.2
Using the EHR system in my practice has (will) increased	32	-1.576	-1.716	0.14

I believe that all stakeholders' interested in promoting	10	-0.828	-0.923	0.095
The ability to interface with hospitals is the biggest	15	-0.353	-0.326	-0.026
The most common reason for failure of implementation is	18	0.002	0.11	-0.108
Learning to operate the system was (will be) easy for me.	43	-1.569	-1.458	-0.111
There is a need for a buy-in by staff to make them willing	26	0.213	0.342	-0.13
Lack of uniform data standards for the industry makes	17	0.32	0.517	-0.197
Uncertainty about return on investment is a major barrier.	6	0.361	0.593	-0.232
I like to experiment with new information technologies.	44	-1.191	-0.806	-0.385
Organizational factors such as a culture of innovation and	28	0.742	1.13	-0.389
I find it easy to get EMR to do what I need it to do in my	21	-1.333	-0.942	-0.391
A successful EHR implementation requires a project team	20	1.017	1.43	-0.413
My practice is aware of the needs of techno-phobic	16	-0.106	0.569	-0.675
A standalone EHR is not going to solve the issue of	14	-0.138	0.557	-0.695
Entering data into the computer during conversion of	7	0.991	1.71	-0.719
EHR systems may help laypersons and subordinate	47	-0.843	-0.08	-0.763
There is a positive impact on the quality of	23	-1.823	-0.963	-0.86
Timely record conversion and maintenance in an EHR	33	-0.499	0.453	-0.952
I am aware that an EHR technology requires physicians	39	0.45	1.418	-0.968
The CMS pay-for-performance demonstration appear to	27	-0.285	0.715	-1
A physician's own practice group as an organization	19	-0.187	0.88	-1.067
The process of preparing and submitting patient	36	-1.209	-0.064	-1.145
A smaller operating margin related to EHR (electronic	2	0.203	1.462	-1.259
The goals of EHR implementation are to enhance health	11	-1.301	0.255	-1.556
Monetary incentive alone, such as pay-for-performance	3	-0.346	1.317	-1.662
MY staff and I understood that a team approach would	40	0.053	1.734	-1.681
My office was/is able to estimate in close approximation	9	-0.986	0.722	-1.708
Information and support from physicians who are already	24	-0.834	1.342	-2.176

Appendix S: Difference Scores Between Factors 2 and 3 for Nonuser

Descending Array of Differences Between Factors 2 and 3

Statement	No.	Type 2	Type 3	Diff
EHR software leads to excessive use of guidelines,	13	0.108	-2.191	2.299
Monetary incentive alone, such as pay-for-performance	3	0.814	-1.315	2.129
The CMS pay-for-performance demonstration appear to	27	0.87	-1.156	2.026
Information and support from physicians who are already	24	2.084	0.358	1.726
The most common reason for failure of implementation is	18	1.215	-0.318	1.533
Using the EHR may decrease my professional discretion	48	-0.415	-1.793	1.378
EHR systems may help laypersons and subordinate	47	0.525	-0.836	1.362
A physician's own practice group as an organization	19	0.578	-0.758	1.335
The ability to interface with hospitals is the biggest	15	-0.706	-1.992	1.286
My practice is aware of the needs of techno-phobic	16	-0.197	-1.315	1.118
Fear of loss of professional autonomy adds resistance to	4	0.108	-0.996	1.104
A smaller operating margin related to EHR (electronic	2	1.288	0.239	1.049
Loss of short-term productivity is a major concern during	31	2.338	1.315	1.023
Using the system requires a lot of extra effort in my	35	-0.325	-1.275	0.949
A successful EHR implementation requires a project team	20	1.143	0.199	0.944
Finding a CCHIT certified EHR is (has been) a concern as	38	0.433	-0.478	0.911
I may not/did not receive essential guidance or explanation	46	0.996	0.159	0.837
There is a positive impact on the quality of communication	23	-0.18	-0.917	0.736
Using EHR may increase monitoring and reviewing of	50	0.832	0.12	0.712
Confidentiality and security add more costs to a	30	0.398	-0.08	0.478
I am aware that an EHR technology requires physicians	39	0.689	0.279	0.41
Capacity within my practice to select, install, and contract	37	0.779	0.557	0.222
I believe that all stakeholders' interested in promoting EHR	10	-1.033	-1.156	0.123

The process of preparing and submitting patient	36	-0.163	-0.239	0.076
Physicians should not be spending their time dealing	34	0.47	0.398	0.071
The goals of EHR implementation are to enhance health	11	-0.237	-0.279	0.042
Entering data into the computer during conversion of paper	7	0.872	0.877	-0.005
A standalone EHR is not going to solve the issue of	14	0.526	0.558	-0.032
Top management’s response to training for EHR has been	45	0.524	0.637	-0.113
Financial incentives can clearly modify EHR adoption	5	0.491	0.798	-0.307
Using EMR enables me to complete patient encounter	12	-1.231	-0.917	-0.315
It has been easy to tailor the system to how my practice	22	-0.762	-0.398	-0.363
Organizational factors such as a culture of innovation and	28	0.943	1.315	-0.372
The way the system is designed is (maybe) inconsistent	25	-0.38	0	-0.38
Lack of uniform data standards for the industry makes	17	0.289	0.677	-0.389
I have concerns if my standalone EHR system becomes	49	0.272	0.836	-0.565
My office was/is able to estimate in close approximation	9	-1.214	-0.637	-0.576
I find it easy to get EMR to do what I need it to do in my	21	-1.087	-0.478	-0.609
Uncertainty about return on investment is a major barrier.	6	-1.143	-0.518	-0.625
There is a need for a buy-in by staff to make them willing	26	-0.689	0.199	-0.889
I like to experiment with new information technologies.	44	0.201	1.235	-1.033
Physicians find lack of time to acquire knowledge about	8	0.962	2.191	-1.229
MY staff and I understood that a team approach would best	40	-0.527	0.717	-1.244
Timely record conversion and maintenance in an EHR	33	-0.923	0.558	-1.482
I can use the system easily while I perform a medical	42	-1.85	-0.278	-1.571
Using the EHR system in my practice has (will) increased	32	-1.322	0.279	-1.601
Loss of long-term productivity is a major concern during	29	-1.271	1.235	-2.505
The amount of capital and the availability of capital needed	1	-1.106	1.793	-2.899
Learning to operate the system was (will be) easy for me.	43	-2.138	1.036	-3.174
It is easy for me to become skillful in the use of EHR	41	-1.848	1.753	-3.601

Appendix T: Correlational Matrix for Q-Sort for Users of the Electronic Health Record System

Correlation Matrix Between Sorts - Users

	SORTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	A1111U1	100	32	43	33	31	35	18	17	29	26	32	18	27	40	19	-1	5	24	23	23
2	A1112U2	32	100	26	37	23	40	33	45	30	13	30	8	24	22	33	18	-37	56	33	52
3	A1115U4	43	26	100	31	21	30	18	2	26	16	17	11	19	22	34	38	-16	17	11	10
4	A1117U5	33	37	31	100	30	36	13	32	36	9	24	35	3	36	40	31	-7	36	39	48
5	A1118U6	31	23	21	30	100	23	25	11	35	12	18	23	36	-17	1	31	0	13	19	14
6	A1119U7	35	40	30	36	23	100	46	30	47	32	27	11	2	52	45	29	-24	28	38	44
7	A1121U8	18	33	18	13	25	46	100	24	23	33	25	23	26	15	15	18	-19	36	23	43
8	A1122U9	17	45	2	32	11	30	24	100	20	24	22	23	6	34	30	25	-24	39	43	55
9	A1127U11	29	30	26	36	35	47	23	20	100	23	35	26	7	50	60	42	-27	45	33	40
10	A1129U12	26	13	16	9	12	32	33	24	23	100	-2	39	6	19	22	43	-2	23	19	37
11	A1135U14	32	30	17	24	18	27	25	22	35	-2	100	-8	19	32	18	-3	-15	35	4	31
12	A1137U16	18	8	11	35	23	11	23	23	26	39	-8	100	-21	26	39	49	7	47	29	42
13	A1138U17	27	24	19	3	36	2	26	6	7	6	19	-21	100	-14	-8	5	-2	5	0	-5
14	A1139U18	40	22	22	36	-17	52	15	34	50	19	32	26	-14	100	64	17	-10	39	27	31
15	A1142U19	19	33	34	40	1	45	15	30	60	22	18	39	-8	64	100	31	-19	49	50	38
16	A1143U20	-1	18	38	31	31	29	18	25	42	43	-3	49	5	17	31	100	-14	28	30	25
17	A1144U21	5	-37	-16	-7	0	-24	-19	-24	-27	-2	-15	7	-2	-10	-19	-14	100	-24	-19	-39
18	A1147U22	24	56	17	36	13	28	36	39	45	23	35	47	5	39	49	28	-24	100	36	54
19	A1150U23	23	33	11	39	19	38	23	43	33	19	4	29	0	27	50	30	-19	36	100	40
20	A1151U24	23	52	10	48	14	44	43	55	40	37	31	42	-5	31	38	25	-39	54	40	100

Appendix U: Unrotated Factor Matrix for Users of the Electronic Health Record System

Unrotated Factor Matrix - User of EHR System

Factors	1	2	3	4	5	6	7	8
SORTS								
1 A1111U1	0.4937	0.3909	0.0798	0.4262	0.3734	0.0564	-0.2291	-0.164
2 A1112U2	0.6403	0.2883	-0.2607	-0.2618	-0.0288	-0.1483	-0.118	-0.2618
3 A1115U4	0.4334	0.2753	0.2215	0.4165	-0.3786	0.0574	-0.1412	-0.45
4 A1117U5	0.6245	-0.0262	0.0503	0.1553	0.1086	-0.4729	-0.1085	-0.0349
5 A1118U6	0.3582	0.4909	0.5023	-0.0884	-0.0059	-0.3335	0.1344	0.313
6 A1119U7	0.6817	0.0736	-0.0975	0.1378	-0.1184	0.3071	-0.2282	0.3547
7 A1121U8	0.5086	0.2697	0.0771	-0.3362	0.0924	0.4538	0.0838	0.154
8 A1122U9	0.5756	-0.095	-0.1941	-0.3726	0.2079	-0.101	-0.2733	-0.0227
9 A1127U11	0.6927	-0.0098	0.0007	0.2423	-0.2552	-0.0393	0.3391	0.3029
10 A1129U12	0.4471	-0.1349	0.4463	-0.1417	0.1314	0.548	-0.0887	-0.0879
11 A1135U14	0.4159	0.4109	-0.4026	0.1602	0.1911	0.0167	0.426	0.0591
12 A1137U16	0.5005	-0.4615	0.4849	-0.0792	0.2589	-0.0887	0.2259	-0.1564
13 A1138U17	0.1259	0.7614	0.1613	-0.0886	-0.0126	0.0087	-0.065	-0.0279
14 A1139U18	0.6048	-0.2821	-0.3139	0.4926	0.1164	0.2005	-0.0149	0.0421
15 A1142U19	0.6922	-0.3455	-0.126	0.3049	-0.1743	-0.0435	-0.002	0.0368
16 A1143U20	0.5175	-0.1962	0.5487	-0.079	-0.3925	-0.0218	0.0849	-0.0491
17 A1144U21	-0.3424	-0.0551	0.4003	0.3611	0.5903	-0.0553	-0.0161	0.1226
18 A1147U22	0.7032	-0.0913	-0.1337	-0.1598	0.1528	-0.0865	0.3499	-0.2544
19 A1150U23	0.5938	-0.1877	0.0118	-0.124	-0.0128	-0.2605	-0.424	0.2835
20 A1151U24	0.7329	-0.1221	-0.1628	-0.3764	0.1537	0.0142	0.0397	-0.0546
Eigenvalues	6.1478	1.9194	1.6742	1.4999	1.1408	1.105	0.9211	0.8439
% expl.Var.	31	10	8	7	6	6	5	4

Appendix V: Exact Factor 1 Scores in Z-Scores and T-Score Units for Users

Statement	No.	Z-Score	T-Score
The amount of capital and the availability of capital	1	0.72	57
A smaller operating margin related to EHR (electronic	2	-0.42	46
Monetary incentive alone, such as pay-for-performance	3	-1.27	37
Fear of loss of professional autonomy adds resistance	4	0.32	53
Financial incentives can clearly modify EHR adoption	5	-0.67	43
Uncertainty about return on investment is a major barrier	6	-0.13	49
Entering data into the computer during conversion of	7	0.9	59
Physicians find lack of time to acquire knowledge about	8	1.49	65
My office was/is able to estimate in close approximation	9	-1.82	32
I believe that all stakeholders' interested in promoting	10	-0.87	41
The goals of EHR implementation are to enhance health	11	-1.7	33
Using EMR enables me to complete patient encounter	12	-1.42	36
EHR software leads to excessive use of guidelines, the	13	0.19	52
A standalone EHR is not going to solve the issue of	14	0.59	56
The ability to interface with hospitals is the biggest	15	-1.19	38
My practice is aware of the needs of techno-phobic	16	-0.6	44
Lack of uniform data standards for the industry makes	17	0.66	57
The most common reason for failure of implementation	18	0.39	54
A physician's own practice group as an organization in	19	0.28	53
A successful EHR implementation requires a project	20	0.58	56

I find it easy to get EMR to do what I need it to do i	21	-1.76	32
It has been easy to tailor the system to how my practice	22	-1.51	35
There is a positive impact on the quality of communication	23	-1.09	39
Information and support from physicians who are already	24	-0.23	48
The way the system is designed is (maybe) inconsistent	25	1.44	64
There is a need for a buy-in by staff to make them willing	26	0.9	59
The CMS pay-for-performance demonstration appear to	27	-0.93	41
Organizational factors such as a culture of innovation	28	0.86	59
Loss of long-term productivity is a major concern during	29	1.18	62
Confidentiality and security add more costs to a	30	0.72	57
Loss of short-term productivity is a major concern during	31	1.87	69
Using the EHR system in my practice has (will) increase	32	-1.15	39
Timely record conversion and maintenance in an EHR	33	-0.31	47
Physicians should not be spending their time dealing	34	1.26	63
Using the system requires a lot of extra effort in my	35	1.27	63
The process of preparing and submitting patient eval.	36	-1.02	40
Capacity within my practice to select, install, and co	37	1.08	61
Finding a CCHIT certified EHR is (has been) a concern	38	1.04	60
I am aware that an EHR technology requires physicians	39	-0.26	47
MY staff and I understood that a team approach would	40	0.29	53
It is easy for me to become skillful in the use of EHR	41	-0.27	47
I can use the system easily while I perform a medical	42	-1.3	37

Learning to operate the system was (will be) easy for	43	-0.41	46
I like to experiment with new information technologies	44	0.36	54
Top management's response to training for EHR has	45	0.19	52
I may not/did not receive essential guidance or explain	46	0.21	52
EHR systems may help laypersons and subordinate	47	-1.2	38
Using the EHR may decrease my professional discretion	48	0.66	57
I have concerns if my standalone EHR system becomes	49	0.72	57
Using EHR may increase monitoring and reviewing of	50	1.38	64

Note. The output from PQMethod 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix W: Exact Factor 2 Scores in Z-Scores and T-Score Units for Users

Statement	No.	Z-Score	T-score
The amount of capital and the availability of capital	1	0.01	50
A smaller operating margin related to EHR (electronic	2	1.54	65
Monetary incentive alone, such as pay-for-performance	3	2.1	71
Fear of loss of professional autonomy adds resistance	4	-0.1	49
Financial incentives can clearly modify EHR adoption	5	-0.17	48
Uncertainty about return on investment is a major barrier	6	0.04	50
Entering data into the computer during conversion of p	7	2.14	71
Physicians find lack of time to acquire knowledge about	8	0.34	53
My office was/is able to estimate in close approximation	9	0.54	55
I believe that all stakeholders' interested in promotion	10	0.47	55
The goals of EHR implementation are to enhance health	11	0.94	59
Using EMR enables me to complete patient encounter	12	-1.66	33
EHR software leads to excessive use of guidelines, the	13	0.16	52
A standalone EHR is not going to solve the issue of	14	1.94	69
The ability to interface with hospitals is the biggest	15	-1.01	40
My practice is aware of the needs of techno-phobic	16	0.1	51
Lack of uniform data standards for the industry makes	17	1.18	62
The most common reason for failure of implementation	18	-0.26	47
A physician's own practice group as an organization in	19	0.27	53

A successful EHR implementation requires a project	20	0.35	53
I find it easy to get EMR to do what I need it to do	21	-0.44	46
It has been easy to tailor the system to how my practice	22	-0.4	46
There is a positive impact on the quality of communication	23	-0.59	44
Information and support from physicians who are already	24	-0.91	41
The way the system is designed is (maybe) inconsistent	25	0.49	55
There is a need for a buy-in by staff to make them willing	26	-0.21	48
The CMS pay-for-performance demonstration appear to ha	27	0.48	55
Organizational factors such as a culture of innovation	28	0.83	58
Loss of long-term productivity is a major concern during	29	-1.84	32
Confidentiality and security add more costs to a	30	0.25	52
Loss of short-term productivity is a major concern during	31	-2.16	28
Using the EHR system in my practice has (will) increase	32	-0.5	45
Timely record conversion and maintenance in an EHR	33	0.54	55
Physicians should not be spending their time dealing	34	-0.22	48
Using the system requires a lot of extra effort in my	35	-0.29	47
The process of preparing and submitting patient eval.	36	-0.2	48
Capacity within my practice to select, install, and	37	-0.34	47
Finding a CCHIT certified EHR is (has been) a concern	38	0.77	58
I am aware that an EHR technology requires physicians	39	0.56	56
MY staff and I understood that a team approach would	40	-0.07	49
It is easy for me to become skillful in the use of EHR	41	-0.4	46

I can use the system easily while I perform a medical	42	-1.39	36
Learning to operate the system was (will be) easy for	43	-1.45	35
I like to experiment with new information technologies	44	-1.25	38
Top management's response to training for EHR has been	45	-1.81	32
I may not/did not receive essential guidance or explanation	46	0.85	58
EHR systems may help laypersons and subordinate	47	0.43	54
Using the EHR may decrease my professional discretion	48	-0.22	48
I have concerns if my standalone EHR system becomes	49	1.73	67
Using EHR may increase monitoring and reviewing of	50	-1.14	39

Note. The output from PQMethod 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix X: Exact Factor 3 Scores in Z-Scores and T-Score Units for Users

Statement	No.	Z-Score	T-score
The amount of capital and the availability of capital	1	-0.68	43
A smaller operating margin related to EHR (electronic	2	0.5	55
Monetary incentive alone, such as pay-for-performance	3	0.81	58
Fear of loss of professional autonomy adds resistance	4	-0.96	40
Financial incentives can clearly modify EHR adoption	5	0.22	52
Uncertainty about return on investment is a major	6	1.33	63
Entering data into the computer during conversion of	7	0.52	55
Physicians find lack of time to acquire knowledge about	8	-0.84	42
My office was/is able to estimate in close approximation	9	1.23	62
I believe that all stakeholders' interested in promotion	10	-1.19	38
The goals of EHR implementation are to enhance health	11	0.85	59
Using EMR enables me to complete patient encounter	12	-1.71	33
EHR software leads to excessive use of guidelines, the	13	-0.83	42
A standalone EHR is not going to solve the issue of	14	-0.25	47
The ability to interface with hospitals is the biggest	15	0.06	51
My practice is aware of the needs of techno-phobic	16	0.99	60
Lack of uniform data standards for the industry makes	17	0.32	53
The most common reason for failure of implementation	18	-0.35	46
A physician's own practice group as an organization in	19	0.63	56
A successful EHR implementation requires a project	20	0.77	58

I find it easy to get EMR to do what I need it to do i	21	-0.18	48
It has been easy to tailor the system to how my practice	22	-0.77	42
There is a positive impact on the quality of comunication	23	-1.12	39
Information and support from physicians who are already	24	1.91	69
The way the system is designed is (maybe) inconsistent	25	-1.54	35
There is a need for a buy-in by staff to make them willing	26	0.81	58
The CMS pay-for-performance demonstration appear to	27	0.24	52
Organizational factors such as a culture of innovation	28	0.81	58
Loss of long-term productivity is a major concern during	29	1.03	60
Confidentiality and security add more costs to a	30	0.43	54
Loss of short-term productivity is a major concern during	31	0.66	57
Using the EHR system in my practice has (will) increase	32	-1.57	34
Timely record conversion and maintenance in an EHR	33	1.27	63
Physicians should not be spending their time dealing	34	-1.22	38
Using the system requires a lot of extra effort in my	35	1.23	62
The process of preparing and submitting patient eval.	36	-0.07	49
Capacity within my practice to select, install, and	37	-0.94	41
Finding a CCHIT certified EHR is (has been) a concern	38	-1.11	39
I am aware that an EHR technology requires physicians	39	1.19	62
MY staff and I understood that a team approach would	40	2.05	71
It is easy for me to become skillful in the use of EHR	41	-1.05	39
I can use the system easily while I perform a medical	42	-0.56	44

Learning to operate the system was (will be) easy for	43	-0.3	47
I like to experiment with new information technologies	44	0.29	53
Top management's response to training for EHR has	45	0.99	60
I may not/did not receive essential guidance or explain	46	-1.85	32
EHR systems may help laypersons and subordinate	47	-0.17	48
Using the EHR may decrease my professional discretion	48	-0.65	43
I have concerns if my standalone EHR system becomes	49	-1.48	35
Using EHR may increase monitoring and reviewing of	50	0.22	52

Note. The output from PQMethod 2.20 provided truncated statements; for completed statements see Appendix B.

Appendix Y: Factor Arrays for Users of the Electronic Health Record System

		Factor Arrays		
	Statement	1	2	3
1	The amount of capital and the availability of capital needed	1	1	-1
2	A smaller operating margin related to EHR (electronic health	-1	4	1
3	Monetary incentive alone, such as pay-for-performance and	-2	5	2
4	Fear of loss of professional autonomy adds resistance to	0	0	-1
5	Financial incentives can clearly modify EHR adoption	-2	-1	1
6	Uncertainty about return on investment is a major barrier.	1	2	4
7	Entering data into the computer during conversion of paper	4	5	4
8	Physicians find lack of time to acquire knowledge about the	5	1	-2
9	My office was/is able to estimate in close approximation the	-4	3	3
10	I believe that all stakeholders' interested in promoting EHR	-2	2	-4
11	The goals of EHR implementation are to enhance healthcare	-3	2	-1
12	Using EMR enables me to complete patient encounter more	-5	-5	-5
13	EHR software leads to excessive use of guidelines, therefore	0	2	-1
14	A standalone EHR is not going to solve the issue of	1	4	-1
15	The ability to interface with hospitals is the biggest	-3	-4	0
16	My practice is aware of the needs of techno-phobic	-1	2	2
17	Lack of uniform data standards for the industry makes	2	4	2
18	The most common reason for failure of implementation is	0	-2	0
19	A physician's own practice group as an organization	1	1	3

20	A successful EHR implementation requires a project team	3	0	3
21	I find it easy to get EMR to do what I need it to do in my	-5	-2	-3
22	It has been easy to tailor the system to how my practice	-5	-2	-3
23	There is a positive impact on the quality of communication	-3	-1	-4
24	Information and support from physicians who are already	-1	-3	5
25	The way the system is designed is (maybe) inconsistent with	3	1	-2
26	There is a need for a buy-in by staff to make them willing	3	0	1
27	The CMS pay-for-performance demonstration appear to have	-2	-1	0
28	Organizational factors such as a culture of innovation and	4	3	2
29	Loss of long-term productivity is a major concern during the	4	-3	3
30	Confidentiality and security add more costs to a	2	0	1
31	Loss of short-term productivity is a major concern during	5	-5	5
32	Using the EHR system in my practice has (will) increased	-4	-3	-5
33	Timely record conversion and maintenance in an EHR	0	3	1
34	Physicians should not be spending their time dealing directly	3	0	-3
35	Using the system requires a lot of extra effort in my practice	5	0	4
36	The process of preparing and submitting patient evaluations	-3	-1	0
37	Capacity within my practice to select, install, and contract	2	-2	-3
38	Finding a CCHIT certified EHR is (has been) a concern as	2	1	-2
39	I am aware that an EHR technology requires physicians and	-1	3	3
40	MY staff and I understood that a team approach would best	2	-1	5
41	It is easy for me to become skillful in the use of EHR	-2	-1	-3

42	I can use the system easily while I perform a medical	-4	-5	-2
43	Learning to operate the system was (will be) easy for me.	-1	-4	-2
44	I like to experiment with new information technologies.	0	-3	-1
45	Top management's response to training for EHR has been	0	-3	1
46	I may not/did not receive essential guidance or explanation	-1	3	-5
47	EHR systems may help laypersons and subordinate	-3	1	0
48	Using the EHR may decrease my professional discretion over	1	-2	0
49	I have concerns if my standalone EHR system becomes	1	5	-4
50	Using EHR may increase monitoring and reviewing of	3	-4	2

Appendix Z: Difference Scores Between Factors 1 and 2 for Users

Descending Array of Differences Between Factors 1 and 2

Statement	No.	Type 1	Type 2	Diff
Loss of short-term productivity is a major concern during	31	1.705	-1.547	3.253
Using EHR may increase monitoring and reviewing of	50	1.078	-1.542	2.62
Loss of long-term productivity is a major concern during	29	1.209	-1.021	2.23
Using the system requires a lot of extra effort in my practice	35	1.702	0.139	1.563
Top management's response to training for EHR has been	45	0.26	-1.256	1.516
I like to experiment with new information technologies.	44	0.24	-1.108	1.348
Capacity within my practice to select, install, and contract	37	0.65	-0.611	1.261
Using the EHR may decrease my professional discretion	48	0.439	-0.724	1.163
Physicians should not be spending their time dealing direct	34	0.992	-0.067	1.058
Learning to operate the system was (will be) easy for me.	43	-0.545	-1.546	1.001
Physicians find lack of time to acquire knowledge about	8	1.333	0.366	0.967
Information and support from physicians who are already	24	-0.041	-0.966	0.925
MY staff and I understood that a team approach would best	40	0.775	-0.148	0.923
There is a need for a buy-in by staff to make them willing	26	1.029	0.129	0.9
The most common reason for failure of implementation is	18	0.167	-0.676	0.843
A successful EHR implementation requires a project team	20	0.845	0.046	0.798
The way the system is designed is (maybe) inconsistent	25	1.126	0.328	0.798
Confidentiality and security add more costs to a	30	0.829	0.225	0.605
Finding a CCHIT certified EHR is (has been) a concern as	38	0.673	0.339	0.334
The amount of capital and the availability of capital needed	1	0.53	0.253	0.277
The ability to interface with hospitals is the biggest	15	-1.248	-1.497	0.249
I can use the system easily while I perform a medical	42	-1.551	-1.697	0.147
A physician's own practice group as an organization	19	0.392	0.254	0.138

Fear of loss of professional autonomy adds resistance to	4	0.17	0.176	-0.005
Using EMR enables me to complete patient encounter	12	-1.889	-1.877	-0.012
Financial incentives can clearly modify EHR adoption	5	-0.659	-0.465	-0.193
Organizational factors such as a culture of innovation and	28	1.156	1.372	-0.215
Uncertainty about return on investment is a major barrier.	6	0.274	0.512	-0.238
EHR software leads to excessive use of guidelines,	13	0.084	0.455	-0.371
It is easy for me to become skillful in the use of EHR tech	41	-0.659	-0.123	-0.537
I am aware that an EHR technology requires physicians	39	0.072	0.621	-0.549
Lack of uniform data standards for the industry makes	17	0.771	1.395	-0.624
Using the EHR system in my practice has (will) increased	32	-1.508	-0.862	-0.647
The CMS pay-for-performance demonstration appear to	27	-0.817	-0.109	-0.708
The process of preparing and submitting patient	36	-1.024	-0.294	-0.73
My practice is aware of the needs of techno-phobic	16	-0.385	0.399	-0.784
There is a positive impact on the quality of communication	23	-1.367	-0.488	-0.878
Timely record conversion and maintenance in an EHR	33	0.166	1.086	-0.92
A standalone EHR is not going to solve the issue of	14	0.647	1.595	-0.948
Entering data into the computer during conversion of paper	7	1.148	2.142	-0.995
I find it easy to get EMR to do what I need it to do in my p	21	-1.762	-0.739	-1.023
I have concerns if my standalone EHR system becomes	49	0.592	1.671	-1.079
It has been easy to tailor the system to how my practice	22	-1.653	-0.559	-1.094
I may not/did not receive essential guidance or explanation	46	-0.198	1.103	-1.3
I believe that all stakeholders' interested in promoting EHR	10	-1	0.387	-1.387
A smaller operating margin related to EHR (electronic	2	0.075	1.549	-1.474
EHR systems may help laypersons and subordinate	47	-1.235	0.249	-1.485
The goals of EHR implementation are to enhance health	11	-1.398	0.467	-1.865
My office was/is able to estimate in close approximation	9	-1.412	0.74	-2.152
Monetary incentive alone, such as pay-for-performance and	3	-0.778	1.927	-2.705

Appendix AA: Difference Scores Between Factors 1 and 3 for Users

Descending Array of Differences Between Factors 1 and 3

Statement	No.	Type 1	Type 3	Diff
Physicians should not be spending their time dealing direct	34	0.992	-1.187	2.178
I have concerns if my standalone EHR system becomes	49	0.592	-1.44	2.032
Physicians find lack of time to acquire knowledge about	8	1.333	-0.676	2.01
Capacity within my practice to select, install, and contract	37	0.65	-1.21	1.86
The way the system is designed is (maybe) inconsistent	25	1.126	-0.708	1.834
I may not/did not receive essential guidance or explanation	46	-0.198	-1.614	1.416
Finding a CCHIT certified EHR is (has been) a concern as	38	0.673	-0.732	1.405
The amount of capital and the availability of capital needed	1	0.53	-0.466	0.995
A standalone EHR is not going to solve the issue of	14	0.647	-0.24	0.887
Fear of loss of professional autonomy adds resistance to	4	0.17	-0.61	0.781
EHR software leads to excessive use of guidelines,	13	0.084	-0.499	0.583
There is a need for a buy-in by staff to make them willing	26	1.029	0.466	0.563
Using the EHR may decrease my professional discretion	48	0.439	-0.014	0.453
I like to experiment with new information technologies.	44	0.24	-0.171	0.411
It is easy for me to become skillful in the use of EHR tech	41	-0.659	-1.053	0.394
Organizational factors such as a culture of innovation and	28	1.156	0.794	0.363
Learning to operate the system was (will be) easy for me.	43	-0.545	-0.902	0.357
Using the system requires a lot of extra effort in my	35	1.702	1.378	0.324
Loss of short-term productivity is a major concern during	31	1.705	1.414	0.292
Confidentiality and security add more costs to a	30	0.829	0.548	0.281
I believe that all stakeholders' interested in promoting EHR	10	-1	-1.254	0.254
Using EMR enables me to complete patient encounter	12	-1.889	-2.112	0.223
Using EHR may increase monitoring and reviewing of	50	1.078	0.902	0.175
There is a positive impact on the quality of communication	23	-1.367	-1.525	0.159

Loss of long-term productivity is a major concern during	29	1.209	1.096	0.114
Using the EHR system in my practice has (will) increased	32	-1.508	-1.561	0.053
Entering data into the computer during conversion of paper	7	1.148	1.125	0.023
Lack of uniform data standards for the industry makes	17	0.771	0.768	0.003
The most common reason for failure of implementation is	18	0.167	0.168	-0.001
A successful EHR implementation requires a project team	20	0.845	0.967	-0.123
Top management’s response to training for EHR has been	45	0.26	0.411	-0.151
Timely record conversion and maintenance in an EHR	33	0.166	0.357	-0.191
It has been easy to tailor the system to how my practice	22	-1.653	-1.224	-0.429
A smaller operating margin related to EHR (electronic	2	0.075	0.59	-0.514
A physician's own practice group as an organization	19	0.392	1.076	-0.684
I can use the system easily while I perform a medical	42	-1.551	-0.732	-0.819
I find it easy to get EMR to do what I need it to do in my	21	-1.762	-0.905	-0.856
Uncertainty about return on investment is a major barrier.	6	0.274	1.181	-0.907
The CMS pay-for-performance demonstration appear to	27	-0.817	0.112	-0.929
Financial incentives can clearly modify EHR adoption	5	-0.659	0.278	-0.937
I am aware that an EHR technology requires physicians	39	0.072	1.076	-1.004
EHR systems may help laypersons and subordinate	47	-1.235	-0.098	-1.138
The process of preparing and submitting patient	36	-1.024	0.118	-1.142
My practice is aware of the needs of techno-phobic	16	-0.385	0.817	-1.202
The goals of EHR implementation are to enhance health	11	-1.398	-0.186	-1.212
MY staff and I understood that a team approach would best	40	0.775	1.991	-1.217
The ability to interface with hospitals is the biggest	15	-1.248	-0.007	-1.241
Monetary incentive alone, such as pay-for-performance and	3	-0.778	0.814	-1.592
Information and support from physicians who are already	24	-0.041	1.65	-1.691
My office was/is able to estimate in close approximation	9	-1.412	1.029	-2.441

Appendix AB: Difference Scores Between Factors 2 and 3 for Users

Descending Array of Differences Between Factors 2 and 3

Statement	No.	Type 2	Type 3	Diff
I have concerns if my standalone EHR system becomes	49	1.671	-1.44	3.111
I may not/did not receive essential guidance or explanation	46	1.103	-1.614	2.716
A standalone EHR is not going to solve the issue of	14	1.595	-0.24	1.835
I believe that all stakeholders’ interested in promoting EHR	10	0.387	-1.254	1.64
Physicians should not be spending their time dealing directly	34	-0.067	-1.187	1.12
Monetary incentive alone, such as pay-for-performance and	3	1.927	0.814	1.113
Finding a CCHIT certified EHR is (has been) a concern as	38	0.339	-0.732	1.071
Physicians find lack of time to acquire knowledge about the	8	0.366	-0.676	1.043
There is a positive impact on the quality of communication	23	-0.488	-1.525	1.037
The way the system is designed is (maybe) inconsistent with	25	0.328	-0.708	1.036
Entering data into the computer during conversion of paper	7	2.142	1.125	1.018
A smaller operating margin related to EHR (electronic health	2	1.549	0.59	0.959
EHR software leads to excessive use of guidelines, therefore	13	0.455	-0.499	0.953
It is easy for me to become skillful in the use of EHR	41	-0.123	-1.053	0.93
Fear of loss of professional autonomy adds resistance to	4	0.176	-0.61	0.786
Timely record conversion and maintenance in an EHR	33	1.086	0.357	0.729
The amount of capital and the availability of capital needed	1	0.253	-0.466	0.719
Using the EHR system in my practice has (will) increased	32	-0.862	-1.561	0.7
It has been easy to tailor the system to how my practice	22	-0.559	-1.224	0.664
The goals of EHR implementation are to enhance Healthcare	11	0.467	-0.186	0.653
Lack of uniform data standards for the industry makes	17	1.395	0.768	0.627
Capacity within my practice to select, install, and contract	37	-0.611	-1.21	0.599
Organizational factors such as a culture of innovation and	28	1.372	0.794	0.578
EHR systems may help laypersons and subordinate	47	0.249	-0.098	0.347

Using EMR enables me to complete patient encounter more	12	-1.877	-2.112	0.236
I find it easy to get EMR to do what I need it to do in my	21	-0.739	-0.905	0.166
The CMS pay-for-performance demonstration appear to have	27	-0.109	0.112	-0.22
My office was/is able to estimate in close approximation the	9	0.74	1.029	-0.289
Confidentiality and security add more costs to a	30	0.225	0.548	-0.324
There is a need for a buy-in by staff to make them willing	26	0.129	0.466	-0.337
The process of preparing and submitting patient evaluations	36	-0.294	0.118	-0.412
My practice is aware of the needs of techno-phobic	16	0.399	0.817	-0.418
I am aware that an EHR technology requires physicians and	39	0.621	1.076	-0.456
Learning to operate the system was (will be) easy for me.	43	-1.546	-0.902	-0.644
Uncertainty about return on investment is a major barrier.	6	0.512	1.181	-0.669
Using the EHR may decrease my professional discretion over	48	-0.724	-0.014	-0.71
Financial incentives can clearly modify EHR adoption	5	-0.465	0.278	-0.744
A physician's own practice group as an organization influenc	19	0.254	1.076	-0.822
The most common reason for failure of implementation is	18	-0.676	0.168	-0.844
A successful EHR implementation requires a project team	20	0.046	0.967	-0.921
I like to experiment with new information technologies.	44	-1.108	-0.171	-0.937
I can use the system easily while I perform a medical evaluat	42	-1.697	-0.732	-0.966
Using the system requires a lot of extra effort in my practice	35	0.139	1.378	-1.239
The ability to interface with hospitals is the biggest	15	-1.497	-0.007	-1.49
Top management’s response to training for EHR has been	45	-1.256	0.411	-1.667
Loss of long-term productivity is a major concern during the	29	-1.021	1.096	-2.116
MY staff and I understood that a team approach would best	40	-0.148	1.991	-2.139
Using EHR may increase monitoring and reviewing of	50	-1.542	0.902	-2.445
Information and support from physicians who are already	24	-0.966	1.65	-2.616
Loss of short-term productivity is a major concern during the	31	-1.547	1.414	-2.961

Ritu Tannan

CURRENT POSITION

Assistant Professor, Information Technology
Marian School of Business
Marian University of Fond du Lac, WI.

EDUCATION

Doctor of Philosophy – Applied Management and Decision Science
Expected 2012
Walden University

Masters of Business Administration 1993
University of Wisconsin, Oshkosh, Wisconsin

Bachelor of Science 1982
University of Delhi, New Delhi, India

WORK EXPERIENCE

Assistant Professor, Information Technology, Marian University,
Fond du Lac, WI *August, 2009 - Present*

Duties include the teaching of four classes per semester, selecting textbooks and lab manuals, testing and evaluating new software products, and serving on multiple college committees.

Significant Accomplishments:

- Organized a conference with co-sponsorship of Wisconsin Association of Independent Colleges and Universities (WAICU) titled 'Enriching Learning with Learning Management System Conference 2010' on pedagogy integration within a learning management system.
- Added TEC 214 Web Design and E-commerce service learning course with a focus of website development for local small businesses
- Facilitated the Senior Technology Seminar course in the IT curriculum as a professional development course
- Transformed and facilitated TEC 403 Advanced Computer Application/Systems course as an elective using problem solving and critical thinking skills with the help of business cases
- Delivered a mixed model of on-line/face-to-face IT courses for PACE IT courses
- Perform protocol reviews for research projects by serving as a member on Institutional Review Board

- Participated in Marian University's School of Business Friends and Masters Day, an event to connect the School of Business with business alumni and the local business community

Instructor, School of Business, Marian University, Fond du Lac, WI (2004 to 2009)

Responsibilities:
- Provide comprehensive curricular support to undergraduate students by designing, updating, and coaching business and technology course curriculum.
- Perform protocol reviews for research projects by serving on Institutional Review Board.
- Participate in academic program and division operations by serving on formal and informal committees.
- Facilitate communication and feedback on issues pertaining to a course management system by participating in Wisconsin Course Management System Consortium (WICMSC).

Committee Services – Marian University:

2010 Chair person, "Enriching Learning with a Learning Management System" conference in collaboration with Wisconsin Independent Colleges and Universities
2009 - present: Marian University Institutional Review Board for the Protection of Human Subjects
2008 – 2010: WICMSC - Wisconsin CMS (Course Management Software) Consortium
2008 - 2009: Technology Steering Committee
2008: Assessment Academy
2008: Search Committee for faculty selection in the School of Criminal Justice
2007 - 2009: Equity and Inclusion Advisory Council
2007 - 2008: Search Committee for Provost for Marian University
2007: Search Committee for Interim Vice President of Academic Affairs
2006 - present: Nomination Committee
2006 - 2007: Strategic Panning Subcommittee
2006 - 2009: General Education Committee

Computer Systems Consultant, Wisconsin Paper Group, Neenah, WI 2003
- Managed and supported the client/server and proprietary applications
- Managed the upgrade and redesign of the freight scheduling system
- Managed and supported the systems security

Network Administrator, Wealth Management LLC, Appleton, WI 2000-2003
- Managed and oversaw the relocation of the computer network to the new location
- Purchased the network equipment and other consulting services

- Administered and upgraded the Microsoft network and supported financial planning software applications.
- Trained employees on Microsoft and financial planning applications.
- Developed Disaster Recovery Plan for 2002 and 2003.

IT Technician, Wisconsin Paper Group, Neenah, WI. 1999-2000

- Provided hardware and software support for Windows network.

Office Manager, Family Practice, Oshkosh, WI 1995-1998

- Managed a medical office by overseeing the medical records, medical billing and human resources.

CONSULTING/TRAINING

Cerebral Palsy of Mideast Wisconsin, Oshkosh, WI 2006 - present

- Oversaw the conversion of peer-to-peer to a client/server network
- Implemented the website and related analytics
- Oversaw the new website development 2006 - 2010
- Organized public relations strategic goals and objectives. 2010 - present

Tannan Family Practice - Medical Office, Oshkosh, WI 2000 – present

- Implemented systems for a complete practice management (PMS) 2009 and electronic management records (EMR).
- Maintain and support security systems for practice management software.

COMMUNITY SERVICE

United Way of Oshkosh, Wisconsin, Hooper Building, Oshkosh, WI

Board of Directors 2011- present

Cerebral Palsy of Mideast Wisconsin, Inc., 36 Broad St, Oshkosh, WI

Board of Directors 2006 – present
Vice president, Board of Directors 2011 - present
Chairperson, Public Relations Committee 2010 - present
Member, Strategic Planning Committee 2007
Fund-raising Volunteer 2007 - present

IndUS of Fox Valley, 18 Woodbury Court, Appleton, WI

Board of Directors 1999-2006
Chairperson, Banquet Committee 2003
Member, Steering Committee 1999-2005

Wave Robotics, Oshkosh, Wisconsin

Presenter: Web Design 2008

First Lego League, Oshkosh

Judge: Team performance element 2010 and 2011

One Oshkosh, Diversity Circles, Oshkosh

Diversity Circle Demonstration, University of Oshkosh 2009

Diversity Circles 2006 - 2008

PROFESSIONAL MEMBERSHIP

Member, Institute of Electrical and Electronic Engineers 2007 - present

Grants

Service Learning in curriculum 2009

Funding Organization: Institute for Service Learning

Project: Develop a service learning course and implement the curriculum

Leadership and networking in local community 2006

Funding Organization: Marian University

Project: Participate in Oshkosh Chamber of Commerce for community involvement.

Workshops Presented

Alverno College, Milwaukee, WI, May 22, 2009

Presented: My First Educator Course Part1 (Hands On session) and Part 2 (Panel session) – Ucompass - Educator 1.0, Course Management System.

Marian University, Fond du Lac, WI, October 1, 2010

Organized: Conference titled 'Enriching Learning with Learning Management System Conference 2010' on pedagogy integration within a learning management system in co-sponsorship with Wisconsin Association of Independent Colleges and Universities (WAICU).

Session: A round table discussion on how to make students accountable in an online classroom.

Professional Meetings – Conferences

eClinicalWorks RoadShow - The Meaningful Use Tour, Chicago, IL April 2011

Sessions Attended:

- Interactive session which touched on all 25 requirements of meaningful use given by Center for Medicare and Medicaid Services.
- Demonstration of new features in Version 9.0 of eClinicalWorks including the Meaningful Use Dashboards and Report Card

Chairperson, Enriching "Learning" with Learning Management System, October 1, 2010

Marian University, Fond du Lac, Wisconsin

Chairperson, Program Committee

IEEE Communication Society – 17th IEEE International Workshop on Quality of Service,
July 13-15, 2009, Charleston, SC

Sessions Attended:

- Efficient Server Provisioning with End-to-End Delay Guarantee on Multi-tier Clusters
- Online Detection of Network Traffic Anomalies Using Behavioral Distance
- HiDRA-Statistical Multi-dimensional Resource Discovery for Large-Scale Systems

HONORS

Sigma Beta Delta (honoring scholastic excellence in business) 2004 - present

NOMINATIONS FOR HONORS

James R. Underkofler Award for Excellence in Undergraduate Teaching, Marian University 2007