ABSTRACT

PERCEPTION GAPS AND THE ADOPTION OF INFORMATION TECHNOLOGY IN THE CLINICAL HEALTHCARE ENVIRONMENT

by
Karen Hare

Implementation of information systems has lagged in many areas of clinical healthcare for a variety of reasons. Economics, data complexity and resistance are among the often quoted roadblocks. Research suggests that physicians play a major part in the adoption, use and diffusion of information technology (IT) in clinical settings. There are also other healthcare professionals, clinical and non-clinical, who play important roles in making decisions about the acquisition of information technology. In addition to these groups there are information technology professionals providing the services required within the healthcare field. Finally within this group are those IT professionals who have sufficient cross training to understand specific needs. Each member of these groups brings a different perspective to both needs assessments as well as implementation of clinical systems. This study considers the idea that there are preconceived differences of opinion of the information needs of clinical healthcare by the clinical community and the information technology professionals. Are these differences significant enough to create a barrier to implementation?

A questionnaire was developed from preliminary data to assess multiple parameters which could impact implementation of a clinical information technology solution. A Web of System Performance (WOSP) model was created to map each of the following eight areas of concern: functionality, usability, extendibility, connectivity, flexibility, reliability, privacy and security. Responses to the questions were related to professional roles, age and experience.

There were no differences seen in the perceived need for secure systems by either healthcare workers or IT professionals. The variance of perceived need was greatest among the various non-physician healthcare workers when compared to physicians or information technology professions. This was a consistent pattern for the other

parameters with the exception of the usability of the electronic health record. In this area all groups disagreed significantly. The study, though limited by its small sample, still suggests that the resistance by healthcare professionals is not a significant barrier to successful information technology implementation.

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by
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~ Booker T. Washington ~
1856 - 1916

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GLOSSARY OF TERMS

ARPA – Advanced Research Projects Agency, sponsored by the Department of Defense, became known as ARPANET. Sought to utilize technology to link together a handful of computers that were involved in defense-related research.

ANSI – American National Standards Institute.

Biomedical Informatics - is defined as computer applications in the medical care industry. More specifically, it has been defined as "the study, invention, and implementation of structures and algorithms to improve communication, understanding and management of medical information. The end objective of Biomedical informatics is the coalescing of data, knowledge and the tools necessary to apply that data and knowledge in the decision making process, at the time and place decision making needs to be made" (Medical Informatics FAQ).

CDC – Center for Disease Control and Preventions. Online: http://www.cdc.gov

CHR – Computer-Based Health Records (three types):
- Telemedicine – Care at a distance.
- Telemetric – Measurement of a variety of variables at a distance.
- Tele-Educations – Extend Health Professionals to remote sites.

CMC – Computer Mediated Communication

Connectivity - (WOSP) Enable system interconnections

DOD – Department Of Defense. Online: http:/www.dod.gov

DOE – Department Of Energy. Online: http://www.doe.gov

E-Health Initiatives - E-Health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.
Online: http://www.jmir.org/2001/2/e20/.

EHR - Electronic Health Record that contains relevant information about a patients illness, treatment by physicians and healthcare providers, drugs prescribed, referrals, billing and insurance information.

Extendibility - (WOSP) Enable boundary changes.

Flexibility - (WOSP) Allow desirable changes.

Functionality – (WOSP) Maximize system utility.

HCFA – Health Care Financing Administrations, the arm of HHS that manages Medicare and Medicaid. Online: http://www.hhs.gov.

HCI – Health Care Informatics, the study relating to the development and application of information technology to health care information. Online: http://landfield.com/software/ftp.landfield.com/pub/faqs/medical-informatics-faq.

HCIS – Health Care Information System

HGP – Human Genome Project: The HGP is a worldwide collaborative effort aiming at locating and sequencing all the genes embedded in the twenty-three pairs of human chromosomes.

HII – Health Information Infrastructure

HIMSS – Health Information and Management System Society: A non-profit organization consisting of four professional areas (Clinical systems, Information systems, Management Engineering, Telecommunications) dedicated to the improving the understanding of health care information and management systems. Online: http://www.himss.org/about/aboutus.asp.

HIPAA – Health Insurance Portability and Accountability Act of 1996: Enacted by Congress in an attempt to reform Health Care. HIPAA looks to develop standards and requirements for maintenance and transmission of health information that identifies individual patients. The results of which is improvement in the "efficiency and effectiveness of the healthcare system by standardizing the interchange of electronic data for specified administrative and financial transactions". The act also requires protecting the security and confidentiality of electronic health information (Source: Quadra Med). Online: http://www.hipaa.org.

HIPAA Privacy Act - Regulation number: 45 CRF Part 160 and Part 164, Subparts A and E. Online: http://hhs.gov/ocr/hipaa. The Privacy Rule standards address the use and disclosure of individual's health information – called "protected health information" by organizations subject to the Privacy Rule – called "covered entities," as well as standards for individuals' privacy: the right to understand and control how their information is used.

HIPAA Security Act - Regulation number: 45 CRF Part 160 and Part 164, Subparts A and C. Online: http://www.cms.hhs.gov. The security standards in HIPAA were developed for two primary purposes. First, and foremost, the implementation of appropriate security safeguards protects certain electronic health care information that may be at risk. Second, protecting an individual's health information, while permitting the appropriate access and use of that information, ultimately promotes the use of electronic health information in the industry – an important goal of HIPAA.

HIS – Hospital Information Systems comprises interrelated subsystems that serve individual departments. In turn, each subsystem comprises multiple functional components (Wiederhold and Shorthliffe, p. 201, 2001).

HHS – Health and Human Services. Online: http://www.hhs.gov.

HL7 – Health Level 7: Accredited by ANSI. Specifications for the exchange of electronic data between health care institutions. Particularly hospitals, and between different computer systems within hospitals. It defines the standard message types with required and optional data for each. Messages are defined to be independent of computer systems and communication protocol. Also, they are constructed such that new versions can add data elements without adversely affecting previous versions. Online: http://www.hl7.org.

HPCC Act Of 1991 – High Performance Computing and Communication Act. Promoted in 1989 by Senator Al Gore as a "National Research Program" that would promote technology of the Internet and bring it to a level of quality and sophistication that would attract an even larger segment of society.

IAIMS – Integrated Advanced Information Management Systems (Research Area).

Informatics – Management Information System for the Biomedical/Health Care Industry.

IR – Information Resources

Interoperability – The capability of different programs to exchange data via a common set of business procedures, and to read and write the same file formats and use the same protocols.

IT – Information Technology

Legacy System – ("Antiquated System") an existing computer system or application program which continues to be used because the user (typically an organization) does not want to replace or redesign it.

Medical Informatics – is concerned with managing information content, in contrast to an information system. The emphasis is on standards, and communicating between system components, which focus on the management of information as an enterprise-wide asset, independent of the system that support the various facilities that make up the enterprise (Lorenzi, Riley, Ball and Douglas, 95).

MPI – Master Patient Index.

NCVHS – National Committee on Vital and Health Statistics. Online: http://ncvhs.hhs.gov.

NII – National Information Infrastructure

NPRM – Notice of Proposed Rule Making

Patient-Care System – Comprehensive computer system used by health workers in the management of individual patients, usually in hospital settings.

Patient Record – Another name for the medical record, but one often preferred by those who wish to emphasize that such records need to contain information about patients that extends beyond the details of their diseases and medical or surgical management. Also known as the **Electronic Medical Record or Patient Chart (paper record).**

Privacy – (WOSP) Limit system interconnections.

Public Health – The field that deals with monitoring and influencing trends in habits and disease in an effort to protect or enhance the health of the population.

Query – In a database system, a request for specific information that is stored in the computer. By extension, updates to the database.

Relevance Ranking – The degree to which the results are relevant to the information need specified in a query.

Reliability – In networking, the ability of a networked resource to be available and to meet expectations for performance.

Reliability – (WOSP) Deny undesirable changes.

Security (Data Security) – The process of protecting information from destruction or misuse, including both physical and computer-based mechanisms.

Security – (WOSP) Deny boundary changes.

Super connectivity – 1. The phenomenon of almost perfect transmission of communication and information throughout the human habitations of the universe, via computers. 2. The interconnections of all social and economic institutions as a result of communication via computer networks." (The Online Dictionary of the English Language, unabridged, 2067).

Technology Acceptance Model (TAM) – TAM evaluated the constructs of perceived ease of use and perceived usefulness as it related to intention to use a software application.

Unified Theory of Acceptance and Use of Technology (UTAUT - TAM 2) - formulated, with four core determinants of intention and usage, and up to four moderators of key relationships.

Usability – (WOSP) Reduce system complexity.

WOSP – Web of System Performance. - is a combination of factors that are tied together to form an integrated approach for development. The WOSP model (see Figure 2.8) extends and integrates previous theories, including TAM, the general security model, and non-functional requirements research (Whitworth and Zaic, 2003).

CHAPTER 1

INTRODUCTION

1.1 Overview

Information technology adds considerable value to modern organizations. It plays a major role in the financial viability of health care organizations, like hospitals, but while it is indispensable for hospital administration, the penetration of IT into clinical areas has been low. Although the administrative side of health care enjoys considerable computer support, the clinical side does not. Yet data on clinical errors in patient care, such as incorrect medical dosages, or even treatments, suggest automatic patient data processing could be beneficial. Electronic communication could make available critical health information that is currently often unavailable. Clinical IT support is a key area in the current U.S. E-Health initiative to improve the integration of computers in health care. But clinical health care providers often resist IT support. This has been attributed either to medical conservatism, difficulty in using IT or both. However, doctors and nurses often use complex medical equipment, and in health care laboratories they have readily accepted computer support. A more valid reason for IT resistance may be that clinical health care has unique requirements, specifically data confidentiality and data mobility. The difficulty of combining these criteria in a single IT product may explain why clinical health care lags considerably behind administrative health care in IT support.

Complexities specific to the healthcare domain impact the use and integration with information technology. Gap analysis and the adoption from both the administrative and clinical practitioners who interface with patients was the starting point for this research. A three-phased study that begins with a study at a single public research hospital suggests that there are non-monetary factors that contribute to the gaps in adoption of information technology on the clinical side of healthcare (Hare, Whitworth, Deek and Norris, 2006). These organizational differences are all viewed in relation to the literature review and the first pilot study conducted, which revealed that a gap does exist. The second study expands to multiple hospitals and the third study goes beyond the hospital environment into clinics and doctors' offices. Inhibitors were identified that precluded clinicians from embracing, adopting and automating systems that could help them implement the technology solutions (Hare et al., 2006).

1.2 Problem Statement

Healthcare delivery has been relatively untouched by the revolution in information technology that has transformed nearly every other aspect of society (Institute of Medicine, (IOM), 2001). The two distinct challenges of healthcare are healthcare domain administration and patient care information technology integration. The problem here is exacerbated by the effects of the growing complexities of science and technology, the increase in chronic conditions, a poorly organized delivery system, and constraints on exploiting the revolution in information technology (Institute of Medicine, (IOM), 2001, 2000). Rising healthcare costs include thirty-six billion dollars annually on information technology (Sallas et al., 2007; Frost and Sullivan, 2004). The scientific component also feeds healthcare practitioners at times impeding timely implementation. "Rapid advances in analytical technology coupled with widespread access to large amounts of highly detailed, heterogeneous and often public biomedical research data have dramatically increased the difficulties faced by biomedical investigators in acquiring, archiving, annotating, and analyzing data" (Anderson, Lee, Brockenbrough, Minie, Fuller, Brinkley and Tarczy-Hornoch, 2007). Thus these clinical users requiring IT for their biomedical research and data collection are not technologically savvy in their request. This task is made all the more difficult because IT managers often lack detailed professional knowledge about their professional users, and the context in which IT is used (Sallas, Lane, Mathews, Watkins and Wiley-Patton, 2007). To satisfy healthcare initiatives cross training has become an obstacle.

As shown by Barki and Hartwick (1994), participation is a key factor for the success of the development of a system and the subsequent satisfaction of the users (Lapointe, Lamothe and Fortin, 2006). Hence, user input during the implementation phase has also become important for a proper task/technology fit especially as it relates to the unique requirements for clinical information technology systems.

Research endeavors utilizing TAM/UTAUT (Venkatesh, Moore, Davis and Davis, 2003; Venkatesh, 2003, 2000; Venkatesh and Davis, 1999; Davis, 1989) and GAP analysis (Brown and Swartz, 1989; Parasuraman, Zeithaml and Berry, 1985) speak to the needs of information technology as a whole, not to mention the implications for healthcare systems. These needs have caused both the clinicians to obtain information technology system skills as well as information technology developers to acquire some healthcare background. For instance current research on the Web of System Performance (WOSP) introduces a model that extends beyond traditional TAM models for a flexible, extendable design (Whitworth, Banuls, Cheickna and Mahinda, 2007). For example, Mahinda and Whitworth's (2006; 2005) findings on a browser study related to privacy and security are indicators that parallel regulatory and practitioner needs exist in the healthcare domain.

Evaluating the Medical Informatics milieu in comparison to business application systems, we realize that our current healthcare technologies need improvement. The healthcare industry has gaps in its adoption of IT for some clinical areas, while their business area is functioning on a par with other business industries. Recent research conducted by Sallas et al., (2007) notes that "healthcare IT managers face the daunting task of choosing and implementing technology solutions which are reliable, cost-effective, and improve the quality of healthcare delivery, while introducing technology in a manner that fits the complex workflow involved in delivering patient care."

We are at a pivotal point where determinations need to be made regarding the way in which the U.S. healthcare delivery system is revamped. Models such as the Web of System Performance can aid system development in addressing the unique requirements for the healthcare arena. This research-in-progress places emphasis on "How we align the clinical aspects of healthcare with business processes while restructuring the way information technology can aid in the reduction of medical errors and deliver quality patient care." The findings discussed in this dissertation place emphasis on the first of three studies conducted that look at healthcare alignment. The first study plays a pivotal role in the two subsequent studies due to the technological advances (i.e., wireless) and regulatory changes (i.e., HIPAA) that have taken place in parallel to the studies of this research.

A primary focus of discussion is the evaluation of existing technology that results from an extensive literature review as it relates to the empirical findings of this research.

Findings in the literature reveal that most industries have global links, where integrated data sharing is a focal point of day-to-day operations. In conducting the same type of evaluation of the healthcare industry, it was determined that some areas have virtually no links to vital medical information. Collaborative tools that are specific to researchers' and practitioners' requirements must be developed and integrated with new and existing computer technology, which would allow the user to better service our health delivery system and the patient population.

This research extends across the healthcare domain looking at both the clinical and business application users. A user survey was administered for all studies and is based on two pilot studies that included focus groups and interviews with healthcare and information technology professionals. Emphasis is placed on factors such as resistance toward IT and the perception of users of clinical information technology systems and information technology developers.

CHAPTER 2

LITERATURE REVIEW

To improve healthcare computer integration in the current U.S. E-Health initiative, clinical IT support is a key area. There are a myriad of concerns that have been constant in the prism of healthcare delivery and the need for a new infrastructure for the nation. Only information technology offers society the opportunity to reinvent health care into a more value-driven, knowledge-based, cost-effective industry (Detmer, 95).

The literature begins with a look at the healthcare domain in Section 2.1 which is followed by Sections 2.1.1 – 2.1.7: Challenges in the healthcare domain.

2.1 A Look at the Healthcare Domain

"The need for effective information systems to improve quality of healthcare while controlling costs has never been greater. In fact, many now perceive healthcare as one of the most intensive information service industries — and thus IS/IT , design is especially crucial to physician–to-patient, physician-to-physician and patient-to-patient communication" (Chaisson and Davidson, 2001). Information technology representing the healthcare milieu has not kept pace with the current standards that a health informatics infrastructure requires. Literature reviewed for this research has determined that the gap between clinical and administrative healthcare includes a unique set of requirements for the clinical side. Researchers Wiley-Patton (2004, 2002) and Malloy (2004) report that resistance to information technology is a major issue for clinicians who are now expected to utilize the technology.

Another problem is the legacy systems (antiquated systems) and the integration that has to take place for the exchange of patient information. The data complexity issues are exacerbated by the need for *mobility, privacy, security and flexibility* when protected health information (PHI) is being exchanged electronically.

The research that identified issues that precluded IT adoption in clinical healthcare and the problems associated with healthcare and information technology is established (Hare et al., 2006). There is a disparity between the administrative and clinical sides of healthcare. Traditionally the systems that support hospital information systems have been based on financial applications, which generate monetary gain for fiscal solvency. These are considered administrative systems, which include general accounting (payables and receivables), payroll, patient billing, census management and the operational needs of the hospital or healthcare facility. These have already been automated. On the other hand, some clinical functions like radiology and laser assisted treatment have had the benefits of information technology, but other clinical areas lag behind.

2.1.1 Challenges in the Healthcare Domain

"It is fashionable to bemoan the primitive state of information handling in health services. Indeed, it can be argued that information technology applications lag behind those in other sectors of the modern economy – financial services, retailing, and manufacturing – by as much as a generation. This is not the result of willful incompetence on the part of vendors and health services managers, however. Automating healthcare services is the most demanding application set in the modern economy's most complex product" (Goldsmith, 2005, p. 323).

2.1.2 Existing Problems in Healthcare

The Center for Medicare & Medicaid Services released the latest GDP (Gross Domestic Product) figures for health care spending in the United States at $2 trillion as of January 2005. Not only is the U.S. spending astronomical amounts for governmental programs, but the country currently has a fragmented system that is not covering the insurance requirements of many Americans. "The Center for Disease Control and Prevention reported that 54.5 million people were uninsured for at least part of the year in 2006." Accessed 7/1/07, Online:
(http://www.cdc.gov/nchs/data/nhis/earlyrelease/insur200706.pdf)

Grumbach (2000) indicates that this number of uninsured people in the U.S. has been hovering around the 43 – 44.3 million figures since 1999. According to the Institute of Medicine (IOM, 2004), lack of health insurance causes roughly 18,000 unnecessary deaths every year in the United States. Although America leads the world in spending on healthcare (GDP above), it is the only wealthy industrialized nation that does not ensure that all citizens have coverage. Two huge problems related to the lack of IT in the clinical area are the fact that between 44,000 and 98,000 people die in hospitals each year (IOM, 2000), and 8.8 million adverse drug events are happening in ambulatory care each year (Center for Information Technology Leadership, 2003). Catastrophic illnesses are causing Americans to live in fear that if hospitalized they could face financial ruin.

These major concerns prompted President Bush in 2004 to set aside $100 million over the next ten years to develop an information technology infrastructure to revamp the U.S. healthcare system. Under the Bush administration the Office of the National Coordinator for Health Information Technology (ONCHIT) was established. These planned changes will address information technology for transmittal of patient data, (patient electronic records) and standards that are required for the exchange of information over the internet and among regulatory agencies. The issue of interoperability (capability of different programs to exchange data), which concerns major data complexity issues, is also an important topic that has to be addressed.

David Brailer, M.D., Ph.D., was appointed the first National Health Information Technology Coordinator, but has since resigned. The Health IT Strategic Framework he instituted prior to his resignation in spring 2006 is as follows:

- Improve safety, quality, and efficiency.
- Improve care coordination (system integration, data interoperability).
- Avoid medical error.
- Improve use of resources.
- Reduce variability of care.
- Advance consumer role.
- Strengthen privacy and data protection.
- Promote public health and preparedness.

The previous sections addressed current issues confronting the healthcare milieu and inherent problems that require IT solutions. Figure 2.1 is a schematic that depicts the regulatory bodies that make decisions and regulations and laws that affect IT initiatives for healthcare delivery and patient care. Sections 2.1.4 and 2.1.5 identify domain specific factors that should be evaluated for information technology solutions in the delivery of quality patient care in the U.S. medical environment.

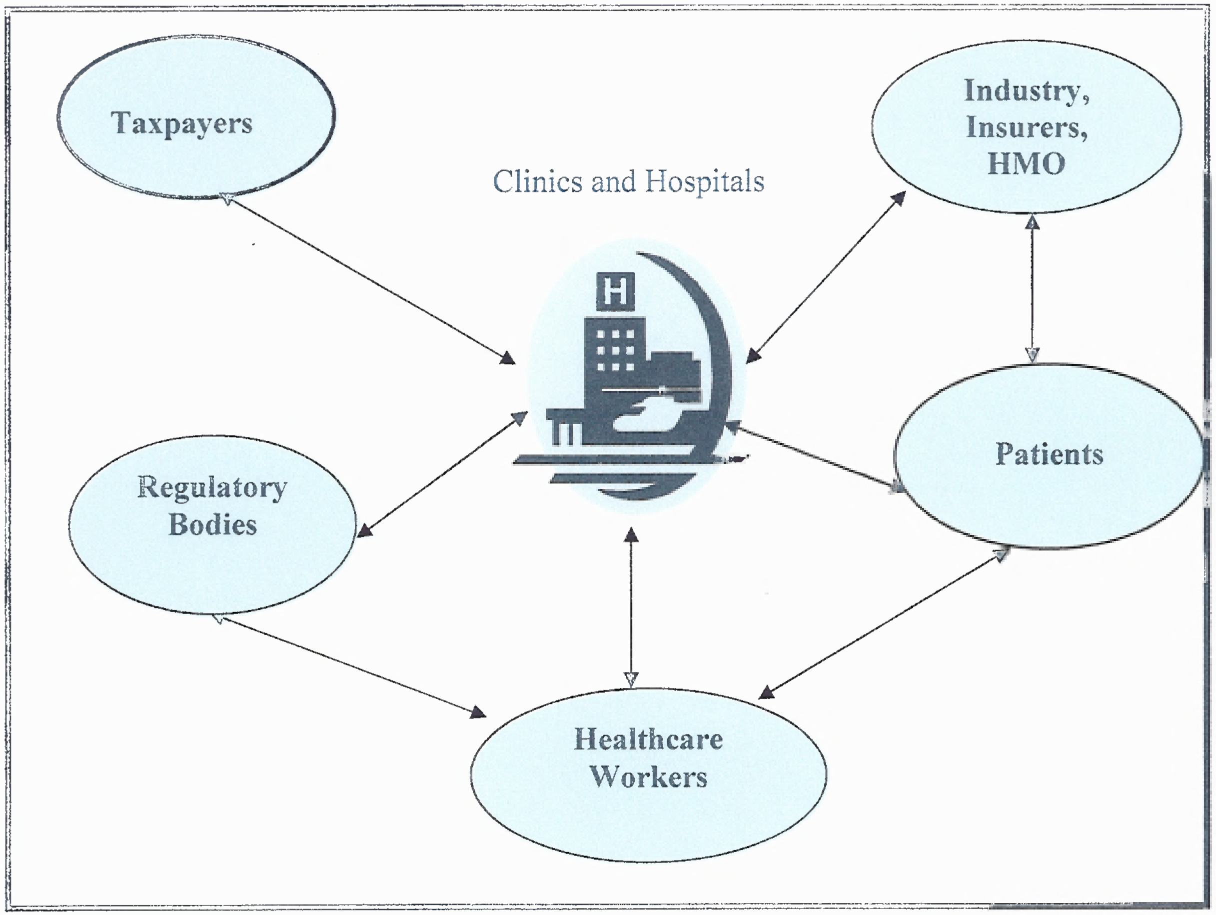


Figure 2.1 Health Care Delivery & Regulation
Adapted from Friedman and Wyatt (1997, p. 5).

2.1.3 Domain Specific Challenges to Healthcare

Administrative healthcare challenges brought forth in the healthcare industry place emphasis on the centralization of information privacy and security, and the sharing of patient medical records across the healthcare domain (physicians, hospitals, insurance, etc). Listed below are four distinct conditions related to the overreaching healthcare delivery process:

1. Centralization of information: There are existing systems with disjointed and overlapping contents. The systems with overlapping contents may have related semantics but different syntax so data integration becomes difficult. The identification of similar content with different labels may or may not be solved in health care (e.g., the name for a drug in the U.S. may have a different name in Europe).
   a) Devise a common structure and format for the existing information and build a system that will integrate the existing formats into an electronic format.
   b) Perform data integration for each existing format.

2. Access and control of medical information: Privacy and security requirements must be maintained for confidential patient information. Hauze (2004) states that "privacy and confidentiality are primary barriers to the expansion of e-business applications for the healthcare industry (E-Health initiatives).

3. Layering effect: Each visit to the doctor begins a new layer in a patient's medical records. The question arises when medical information is deemed irrelevant. E.g., a pregnancy may be over, but the effects of the pregnancy such as diabetes or post partum issues, may have just begun. This information must be integrated easily and efficiently into the existing patient record.

4. Fragmented clinical records: The unavailability of clinical records when needed, currently fragmented across multiple paper sources, has major impacts on patient care and safety, including premature deaths, impaired lives and longer hospital stays (Hare, Whitworth, Deek and Norris, 2006).

2.1.4 Patient Specific Healthcare Challenges

1. Images (tests results) and dates attached to these images.

2. Short-term ailments (pink-eye, strep throat, etc).

3. Long-term ailments (diseases such as, hepatitis, cancer, HIV/AIDS, etc).

4. Change in primary physician – who saw the patient, regular or emergency room physician?

5. Change in medications – name of medication, duration taken, did it work or not?

6. Insurance – what is it, has it changed; e.g., was the company acquired?

7. Heavy updating of information from various manual data sources.

Factors at both the domain level and patient specific level can be successfully addressed with the integration of IT into the delivery of healthcare services.

2.1.5 Gap Analysis

Research and empirical studies are meager in the area of healthcare service quality and the perspective regarding delivery of quality service. Consequently the one article that has yielded numerous citations during the literature review was the Brown and Swartz article (1989), which is "A Gap Analysis of Professional Service Quality," a study for research methodology and experiments. Professional service quality was evaluated for the physician - patient relationships in a medical service delivery area. The patients of thirteen physicians in primary care specializing in family practice or internal medicine took part in the study (Brown and Swartz, 1989). This research study evaluated service quality and satisfaction from the perspective of both the client (patient) and the healthcare provider (physician). The Brown and Swartz (1989) study was one of the first empirical examinations of any service encounter to consider perceptions of both parties in the dyadic exchange (within the healthcare industry).

Such an approach from this previous research made it possible for this researcher to identify and analyze perceptual gaps between clinical healthcare providers of care (physicians and other healthcare providers) and information technology (and healthcare information technology) professionals in this dissertation. The creation of Web of System Performance (WOSP) constructs (see Section 4.4) were designed to test a theory that attempts to explain whether there is a gap in perception; to compare perception differences in participants; and explore physicians' and IT professionals' attitudes and perceptions regarding the existing systems analysis and design of clinical IT requirements. See Perception Differences Tables 4.8 – 4.13 in sections 4.3 - 4.3.6.

2.2 IT Diffusion in Health Care

Healthcare today is characterized by more to know, more to manage, more to watch, more to do, and more people involved in doing it than at any time in the nation's history (IOM, 2001, p. 25). People and organizational issues are critical in both implementing information technology systems and in dealing with the altered organizations that new system implementations invariably create. "As a result, there are substantial challenges and opportunities to the diffusion of IS theory to healthcare as well as in the development and extension of IS theory through studies of healthcare IS/IT" (Chaisson et al., 2004). The problems associated with the development of hospital/health care information systems and their implementation in organizations has been the subject of much literary debate (Wetzel, 2001).

2.2.1 Major Areas of Health IT Adoption in the U.S.

To improve healthcare computer integration in the current U.S. E-Health initiative, clinical IT support is a key area. The U.S. has had medical errors which have led to deaths from

- Drug administration.
- Inaccurate or illegible paper or manual patient medical records (IOM, 2001, 2000).

E-Health can be viewed as a new paradigm for health care information management, encompassing both processing and telecommunication technologies (Tan, 2005). Advances like e-prescriptions, telemedicine, strategic healthcare planning, and E-Health practitioners to individual records are behind this multidisciplinary shift. The E-Health initiative places emphasis on improving the quality, safety, and efficiency of healthcare by leveraging information technology (E-Health, 2006). The adoption of IT by physicians is being forced by E-Health advances, yet resistance to adopt exists (Blumenthal, 2005). The needs for clinical IT adoption are summarized in Figure 2.2 (Hare, Whitworth, Deek and Norris, 2006).

The problem is exacerbated by the growing complexity of IT, an increase in chronic conditions, a poorly organized delivery system, and legal and other social constraints on exploiting the information technology revolution (IOM, 2001, 2000). Yet that the healthcare delivery system has been relatively untouched by the revolution in information that has transformed nearly every other aspect of society is surprising (IOM, 2001).

The slow progress of clinical healthcare computerization has been attributed to a lack of adoption of, or the resistance to, the IT support provided. Research findings by Wiley-Patton (2002, 2004) and Malloy (2004) report that resistance to information technology is a major issue to clinicians expected to use the new technology (Spielman, 2004).

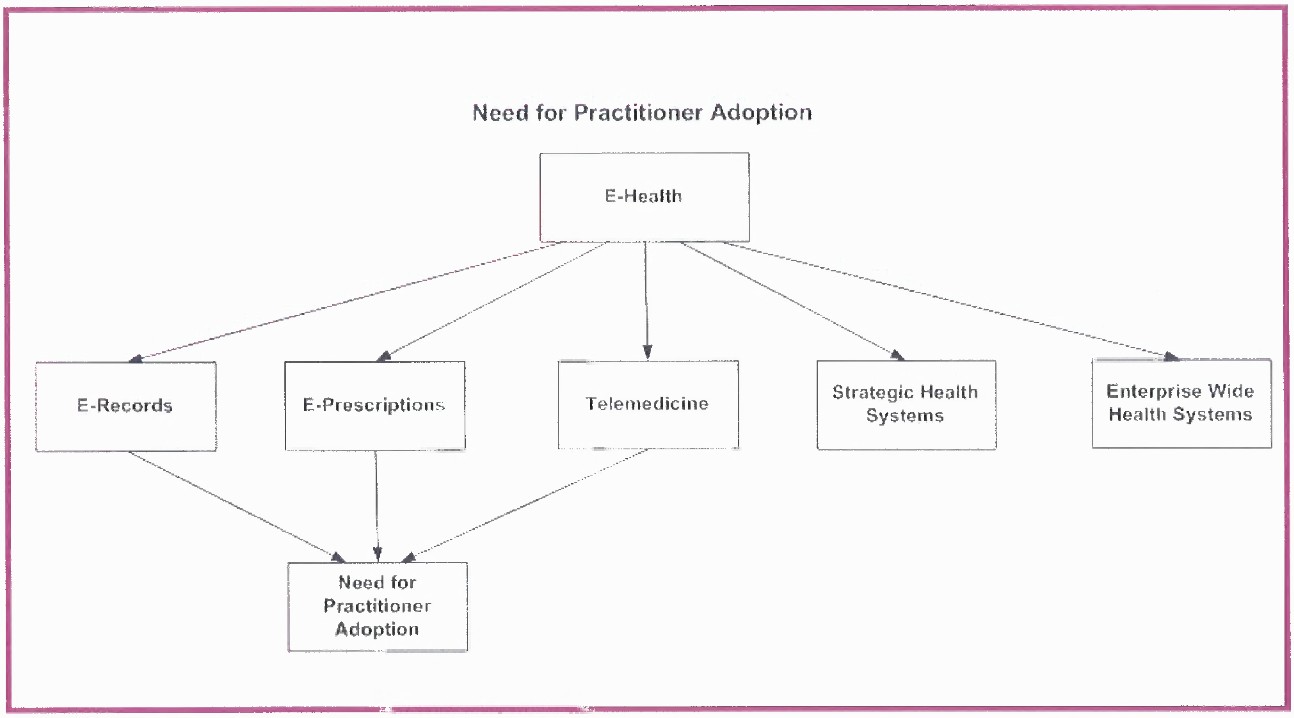


Figure 2.2 Need for Practitioner Adoption.

2.2.2 IT Rejection in Health Care

The enormous difficulty in adapting modern information technology to health services organizations may be attributed to the sheer complexity of these organizations. According to Peter Drucker, the modern urban hospital may be the most complex organization in human history (as cited in Goldsmith, 2005). Successfully introducing major information systems into complex health care organizations requires an effective blend of good technical and good organizational skills (Ash, 2000, Lorenzi and Riley, 2000, Lorenzi and Riley, 95).

The dynamics that affect the acceptance or rejection of an innovation that is diffused rarely have anything to do with whether the application software is clear and functional. Nor do they have anything to do with whether the new functionality can solve all the problems of the last decade.

The organizational environment and political climate have a lot to do with who has the power and the ability to influence other users. The "power" is usually held by the stakeholders or those who have the most to gain, or 'perceive to gain'. The issue here becomes change that will upset the 'way things are done' and "how we have to change from our comfort zone". Dewan, Lorenzi and Zheng, (2004) explain that there is a difference between "resistance to a particular change" and "resistance to the perceived changer(s)". The former relates to the system and the latter happens because of negative feelings about the organization. To this end it becomes important to get buy-in from the user community: those who have a stake in the successful adoption or failure of the implementation that has been diffused (Rogers, 2003: 1995, Lorenzi and Riley, 95). It is important to recognize that organizational changes breed resistance. Maintaining stakeholders' involvement affords IT and Management the opportunity to establish strategies to effectively manage change and synergy to get adoption of newly diffused innovations. In the past several decades, change has been evolutionary and continuous for the U.S. health care milieu. Along with this change there are a multitude of additional variables that have been encountered within the information technology industry.

Human factors (users) within the industry have experienced new ways to do their jobs and sophisticated technological advances that they have to interface with. Some of these changes that foster growth have been embraced by the users, while other users have resisted any attempts to move forward with these technological improvements in the organizational structures. Developers are now spending more time evaluating the cognitive aspects of development as well as involving users of proposed systems to participate in the design and development process (Hartwick and Barki, (1994). "Users who perceive a system to be 'flexible' tend to adopt that system whereas systems perceived to be constraining are not" (Cenfetelli, 2004). When a system is not adopted it is considered a failure. Information technology application system failure can be divided into several categories (Kaplan and Shaw, 2004):

- Systems that fail because of their own weaknesses, i.e., functionality.
- Systems that are more or less technically sound but human factors and resistance prevent/inhibit adoption.
- Systems that have partial successes (but partial failures) due to changes in projection definition or outcome.

2.2.3 Some Reasons for Poor Acceptance of Clinical IT

The adoption of information technology by practitioners is being forced by the advances in e-health records, e-prescriptions, and telemedicine, yet resistance to adopt continues to exist. Hence the theoretical causes of that resistance are currently a major issue. For example, the technology acceptance model (TAM) proposes perceived usefulness and ease of use as the primary determinants of new technology acceptance (Davis, 1989).

Given the potential usefulness of IT based on the reasons outlined above, this leaves poor usability as the main reason for clinical IT resistance. However a study of TAM in a healthcare setting found ease of use was hardly predictive of acceptance at all (Chismar & Wiley-Patton, 2002). That doctors and nurses often use complex and difficult medical equipment may explain why "hard to use" so weakly affected non-acceptance for them. It seems unlikely that the difficulty of use of IT is a critical factor in IT non-adoption by clinical healthcare providers given their professional nature, and their ready use of other complex technologies.

Other common reasons for IT non-acceptance seem equally weak. For example cost could be a factor, but cost has not stopped other health technology advances far more expensive than IT support. That medical providers inherently resist technology is also unlikely. Computers are not only well integrated into healthcare administration, but also into areas staffed by clinicians, like laboratory support, so an intrinsic resistance by medical staff to useful IT seems unlikely.

In considering other reasons for non-IT acceptance a recent Web of System Performance (WOSP) model suggests IT performance is determined by a combination of eight distinct factors: functionality, usability, reliability, flexibility, security, extendibility, connectivity and privacy. The WOSP model extends and integrates previous theories, including TAM, the general security model, and non-functional requirements research (Whitworth and Zaic, 2003).

The framework (Figure 2.2) for information technology adoption is presented where resistance to computerization may explain why clinical IT invokes cross-cutting requirements beyond well known functionality and usability requirements. Evaluation of the literature has determined the importance of matching service provider and receiver perspectives to avoid gaps arising from inconsistent perceptions (Gomes, Passerini, Hare, 2006). Previous studies indicate that there is a critical “gap" between IT providers and IT users in clinical settings (Brown & Swartz, 1989). Practitioners have unique IT requirements that require security and privacy constructs for their adoption.

2.2.4 Outstanding Issues in the Research Community

This section will indicate the various research questions that were cited in the literature and evaluated for a future research question (see Table 2.1). Each citation includes the specific research direction and/or questions for further healthcare informatics evaluation (quoted from the stated publication). These researchers lay out explicit research areas that evaluate people and organizational and social issues. These factors critically interface with the development of information technology design, development and implementation, and must be well thought-out.

Table 2.1 Outstanding Healthcare Informatics Research

Author (s)/Date	Research Issues
Chaisson, Davidson, Kaplan And Kuperman (2004)	1. How useful are IS issues, theories and methods in healthcare settings? Specifically, are the differences important between healthcare and more typical IS settings. 2. What opportunities and challenges confront healthcare and medical informatics researcher in using IS theory? Can IS serve as a reference discipline for healthcare? Should it? 3. What preparation does an IS researcher need before undertaking research in healthcare organizations? 4. What opportunities and challenges does healthcare provide and pose to developing IS knowledge and theory? 5. Are medical informatics issues, theories, and methods useful to IS theory? 6. How could fruitful collaborations of IS and medical informatics research be achieved?
Hersh (2004)	1. What is the need for informatics applications (IT) in healthcare? 2. Is the need for system and data interoperability another challenge? 3. Is the very real concern about privacy and confidentiality an additional impediment?
Kaplan And Shaw (2004)	1. Address concerns of the many individuals involved in or affected by informatics applications. 2. Conduct studies in different size sites, and with different scopes of systems and different groups of users. Do multi-site or multi-system comparative studies. 3. Incorporate evaluation into all phases of a project. 4. Study failures, partial successes, and changes in project definition or outcome. 5. Employ evaluation approaches that take account of the shifting nature of health care and project environments, and do formative evaluations. 6. Incorporate people, social, organizational, culture, and concomitant ethical issues into the mainstream of medical informatics. 7. Diversify research approaches and continue to develop new approaches. 8. Conduct investigations at different levels of analysis. 9. Integrate findings from different applications and contextual settings, different areas of health care, studies in other disciplines, and also work that is not published in traditional research outlets. Develop and test theories to inform further evaluation research and information practices.

2.3 Hospital Information Systems (HIS)

Understanding the healthcare industry's information technology requirements is important for successful diffusion and adoption because each user's departmental needs can be unique and diverse. In this regard the culture of the organizations is inherently a major factor for the success of information technology systems. Part of this culture are the human factors who will work with the automated technology. Social psychology can provide health care informatics with valid and reliable tools to understand issues subsumed under the heading of human factors (Timmons, 2002). Change can only be accompanied by buy-in and ownership of the system by the users within the organization.

The complex nature of healthcare operations contributes to the inertia within the organization. Figure 2.3 reveals the dynamics involved in linking the internal departments and operations within the hospital information system (HIS) and healthcare environment. The challenge lies in using various forms of IT to organize, store, and present health information in a timely and efficient manner for effective health-related decision-making (Raghupathi, 1997). Figure 2.3 is an HIS, a Hospital Information System, which is a centralized hierarchy of nested interrelated subsystems, comprising interrelated subsystems that serve individual departments. In turn, each subsystem constitutes multiple functional components (Wiederhold and Shorthliffe, p. 201, 2001).

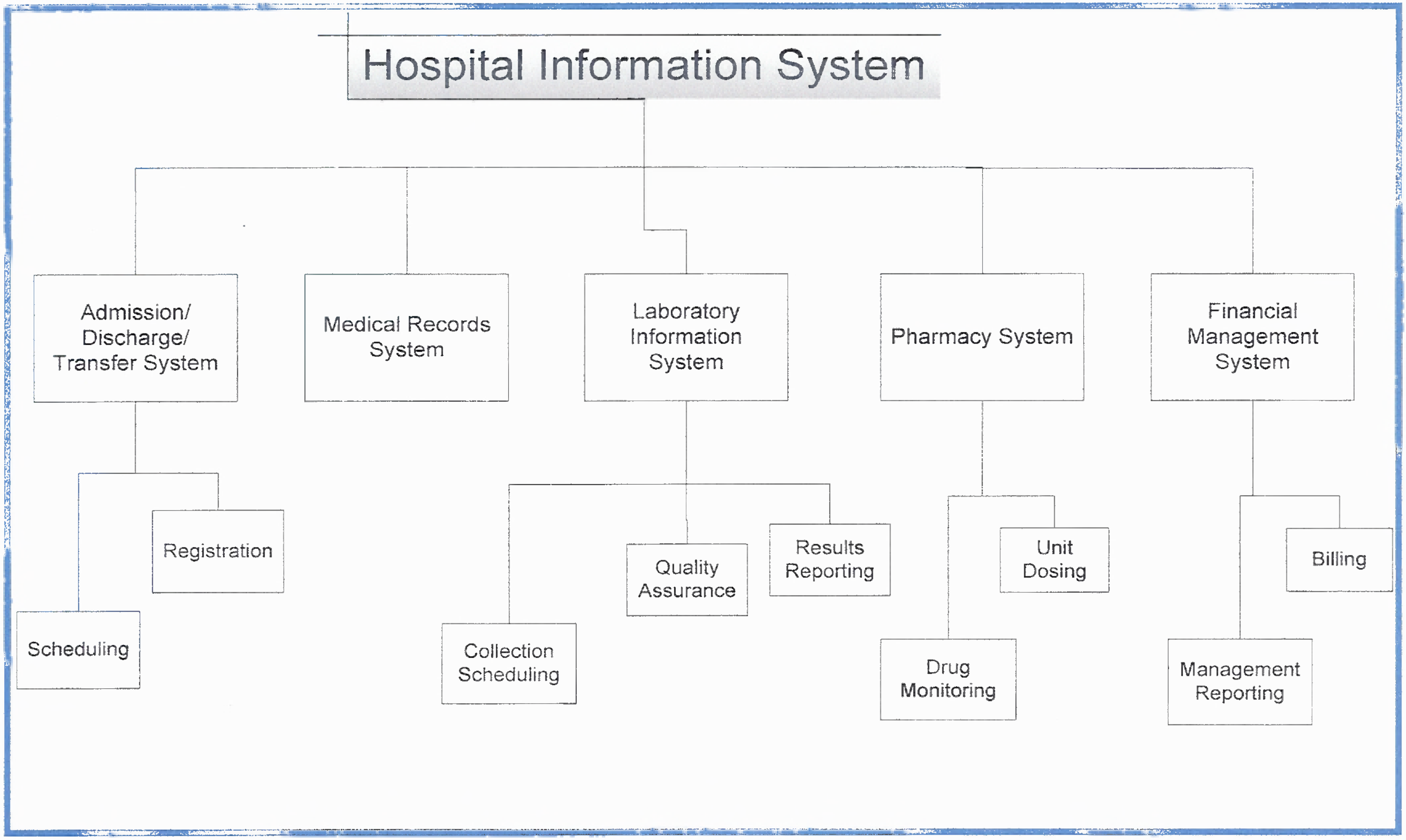


Figure 2.3 Hospital Information Systems (HIS)
Adapted from Wiederhold and Shorthliffe, (p. 201, 2001).

2.3.1 Clinical Systems

Clinical healthcare systems come under the umbrella of hospital information management systems. The various clinical departments within the HMIS (Figure 2.3) deliver specific ancillary services for the patient population. These services can be received in a clinic environment, emergency room, same day surgery, or as an extended hospital stay. Listed below is a comprehensive breakdown of the types of application systems that would be in an HMIS. Figure 2.4 is a comparison chart that exemplifies the distinction between the two major aspects of the HMIS, which is the administrative and clinical healthcare services. As cited in Wiley-Patton (2002, pp. 3-4), "traditionally, the use of computers in medicine has been classified as:

- Administrative Applications - consist of the uses that are not limited to medicine to help facilitate such administrative tasks as patient scheduling, maintaining database records, billing and accounting, and communication with other computers via telecommunication lines and networks.

- Clinical Applications – directly support patient care. These consist of computerized patient monitors, computer-assisted surgery, the development of electronic prosthetics and other medical devices.

- Special Purpose Applications – any applications of computer or information technology to health care that do not fit into the administrative or clinical category are classified as special purpose systems (Burke et al., 2000, p. 61). Special purpose systems include computer-assisted instruction, research databases, expert systems, software that helps in the design and administration of medications, and interactive self-help software. Tools such as MRIs, CT scans and PET scans have been considered special purpose applications."

Administrative Healthcare Systems	Clinical Healthcare Systems
HMIS - Designed to support information requirements of hospitals and university-affiliated medical centers; predominantly for healthcare delivery	**CIS**- Component of HMIS, clinically oriented capabilities, such as order writing and results communication.
Operational needs of the hospital, i.e., census management.	Computerized patient records
Patient billing	Clinical order entry
General accounting (payable, receivables)	Data privacy, confidentially, and security
Payroll	Mobility

Figure 2.4 Comparison chart.

2.3.2 Impacts of Hospital Management Information Systems (HMIS)

"The healthcare industry has been slow to widely adopt electronic solutions for even basic administrative tasks. Privacy and confidentiality are primary barriers to the expansion of e-health solutions (Hauze, 2004, p.11)." Current technology is not adequate; systems are limited and stand alone with virtually no integration of existing patient care records or dedicated applications for integrated information systems. Healthcare today is characterized by more to know, more to manage, more to watch, more to do and more people involved in doing it than at any time in the nation's history (IOM, 2001). A federal mandate in the form of the HIPAA Act of 1996 has impacted HMIS in a major way, by enacting standards for electronic health care transactions.

2.3.3 Health Insurance Portability and Accountability Act (HIPAA)

In 1996 the 104th Congress enacted Public Law 104-191 which is known as the Health Insurance Portability and Accountability Act of 1996 (HIPAA). The department of Health and Human Services (HHS) was designated to establish national standards for electronic health care transactions and national identifiers for providers, health plans, and employers (http://www.cms.hhs.gov/HIPAAGenInfo).

This regulation designated specific rules that apply to security standards and privacy of health-care related information. The HIPAA standards were designed to protect all electronic medical information from inadvertent or intentional improper use or disclosure (Davidson, 2000). The information that will be exchanged and protected will be patients' medical records, which the HIPAA legislation referred to as the Clinical Document Architecture (CDA) or what is currently being referred to in the clinical healthcare environment as the Electronic Medical (EMR) or Health Record (EHR). The CDA provides an exchange model for clinical documents (such as discharge summaries and progress notes) — and brings the healthcare industry closer to the realization of Electronic Health Records (EHR).

As stated above, HIPAA regulations required standards to ensure the transmittal of personally identifiable information electronically and HL7, Health Level Seven, addresses this part of the law. This aspect of the law had to identify ways to receive claims attachments and supplemental information from health insurance carriers and other e-commerce transactions in a uniform manner.

Health Level Seven is one of several American National Standards Institute (ANSI) -accredited Standards Developing Organizations (SDOs) operating in the healthcare arena. Most SDOs produce standards (sometimes called specifications or protocols) for a particular healthcare domain such as pharmacy, medical devices, imaging or insurance (claims processing) transactions. Health Level Seven's domain is clinical and administrative data (www.hl7.org). A key to this process is being able to have message strings that mean the same to both the transmitting system as well as the receiving system; This is done by changing inbound messages to HL7, a commonly agreed-upon standard (became an ANSI approved standard 11/2000).

Health Level 7 Overview:

- Allows disparate systems in the medical enterprise to intercommunicate freely.
- Specifies electronic data exchange between healthcare institutions, particularly hospitals, and between different computer systems within hospitals.
- Orients towards clinical and administrative aspects of the medical enterprise which create the standards for the exchange, management and integration of electronic healthcare information and defines standard message types with required and optional data for each.

Messages are defined to be independent of computer systems and communication protocol, and they are constructed so that later versions of the HL7 standard can add data elements without "breaking" systems using older versions of HL7 (Davidson, 2000). Listed below are the requirements outlined by the HL7 organization to promote effectiveness and efficiency of healthcare delivery within and among healthcare organizations for the benefit of all.

HL7's Strategies (www.hl7.org, Accessed 4/8/2006):

1. Develop coherent, extendible standards that permit structured, encoded health care information of the type required to support patient care, to be exchanged between computer applications while preserving meaning.
2. Develop a formal methodology to support the creation of HL7 standards from the HL7 Reference Information Model (RIM).

3. Educate the healthcare industry, policy makers, and the general public concerning the benefits of healthcare information standardization generally and HL7 standards specifically.

4. Promote the use of HL7 standards world-wide through the creation of HL7 International Affiliate organizations, which participate in developing HL7 standards and which localize HL7 standards as required.

5. Stimulate, encourage and facilitate domain experts from healthcare industry stakeholder organizations to participate in HL7 to develop healthcare information standards in their area of expertise.

6. Collaborate with other standards development organizations and national and international sanctioning bodies (e.g. ANSI and ISO), in both the healthcare and information infrastructure domains to promote the use of supportive and compatible standards.

7. Collaborate with healthcare information technology users to ensure that HL7 standards meet real-world requirements, and that appropriate standards development efforts are initiated by HL7 to meet emergent requirements.

The Department of Health and Human Services (http://www.hhs.gov/) enacted standards pursuant to the HIPAA law (PL 104-191) to improve the efficiency and effectiveness of the health care system and electronic health care transactions. These standards are the HIPAA Security Act and the HIPAA Privacy Act which are discussed in the section that follows:

2.3.4 HIPAA Security Act

Regulation number: 45 CRF Part 160 and Part 164, Subparts A and C (http://www.cms.hhs.gov, Accessed 4/8/2006).

Prior to HIPPA no generally accepted set of security standards or general requirements for protected health information existed in the health care industry. At the same time technologies were evolving, and the health care industry began to move away from paper processes and rely more heavily on the use of computers to pay claims, answer eligibility questions, provide health information and conduct a host of other administrative and clinically based functions.

The security standards in HIPAA were developed for two primary purposes. First, and foremost, the implementation of appropriate security safeguards protects certain electronic health care information that may be at risk. Second, protecting an individual's health information, while permitting the appropriate access and use of that information, ultimately promotes the use of electronic health information in the industry – an important goal of HIPAA.

2.3.5 HIPAA Privacy Act

Regulation number: 45 CRF Part 160 and Part 164, Subparts A and E

(http://hhs.gov/ocr/hipaa, Accessed 4/8/2006)

The Privacy Rule standards address the use and disclosure of individual's health information – called "protected health information" by organizations subject to the Privacy Rule – called "covered entities," as well as standards for individuals' privacy: the right to understand and control how their information is used. Within HHS, the Office for Civil Rights (OCR) has responsibility for implementing and enforcing the Privacy Rule with respect to voluntary compliance activities and civil money penalties.

A major goal of the Privacy Rule is to assure that individuals' health information is properly protected while allowing the flow of health information needed to provide and promote quality health care and to protect the public's health and well-being. The rule strikes a balance that permits important use of information while protecting the privacy of people who seek care and healing. Given that the health care marketplace is diverse, the rule is designed to be flexible and comprehensive to cover the variety of uses and disclosures that need to be addressed.

The Privacy Rule sets the standard for, among other things, who may have access to PHI, while the Security Rule sets the standard for ensuring that only those who should have access to EPHI will actually have access. It is important to note that the Privacy Rule applies to all forms of patients' protected health information, whether electronic, written, or oral. In contrast, the Security Rule covers only protected health information that is in electronic form (http://www.cms.hhs.gov).

2.3.6 Database Security/Electronic Health Record

The U.S. healthcare environment has been under tremendous scrutiny to adhere to IT requirements that keep patient information secure and private. However, patient data is the rich source of documentation that mirrors every step of administered care patients receive when they seek medical treatment. It is this data about a patient's health that was previously maintained in paper folders in file cabinets in doctor's offices or hospital medical records departments that is now the source of much controversy. Currently with increased pressure to keep patients safe and eliminate medically related errors, the paperless computerized medical record (Electronic Health Record\EHR) has emerged (www.hipaa.org; IOM, 2000).

With this technology comes a host of issues that have to be addressed when databases are used as repositories for this type of data. "Generally when talking about data security-in healthcare as well as other areas-the three objectives: confidentiality, integrity, and availability, are identified" (Grütter, 2002). Security features must be inherent in a medical information system due to the confidential nature of sensitive medical data, such as electronic health records. The system should be easily accessible to authorized personnel, yet it should not release information to unauthorized users. HIPAA mandates that data must conform to the standards that ensure patient information, protected.

Security is a major issue. The ongoing question that looms over clinical departments is “How do we secure”? Security has to be implicit in software design and should work hand in hand with computer applications and integration. Coupled with this fact is that security and privacy are also critical for all operating departments. The research from the literature review indicates that these issues are unique to the healthcare environment, and they also cross and impact each other in the design phases of software implementation. Theoretical will be evaluated in Chapter 3 to identify viable options for clinical IT adoption that address security and privacy issues that related to patient data and electronic health records.

There exist a benefit and a challenge at the same time, like order and chaos. The benefit relates to patient safety and the quality of care that each patient receives. The challenge becomes “how to secure” and “how to maintain privacy” at the same time. How can Information Technology be aligned with these two variables and yet maintain flexible systems that are not susceptible or vulnerable to invasion? In order to maintain integrated systems that are compliant with security and privacy standards database must be designed to ensure data integrity.

2.4 HMIS Needs for Databases

The information age has unleashed technology for digital communication and information resources that affect almost every aspect of people's lives, e.g., business, finance, education, government, and entertainment. However, given the current technology which changes daily, this society is not providing state-of-the art medical information technology via integrated computer systems, which would allow healthcare providers to better service their patients. Errors of omission and wrong drug administration have caused deaths in medical facilities at an alarming rate (IOM, 2000).

As with any industry, the requirement to gather and store information and to be able to retrieve this information later is vital. A quandary is that systems that usually house much of the data are all stand-alone, where interaction of any consequence does not exist. This in part is due to legacy systems that are needed to conduct daily business processes, but are not open architecture systems that can handle upgrades without crashes or loss of vital data. Other issues stem from the cost associated with new computer equipment for institutions already struggling with financial constraints.

One of the first issues that must be addressed centers around the legal regulations that have come as a result of federal legislation, i.e., the Health Insurance Portability and Accountability Act 0f 1996 (HIPAA) and electronic (patient) health records. A second issue is control of the various types and quantities of information (data) that the medical industry needs to analyze, manipulate, keep track of, retrieve, store and manage. These data represent vital statistics for patient care/treatment, research and cures for diseases, as well as the development of new drugs, and are found in various databases within the healthcare industry. This information that resides in database applications can contribute to advancements for patient record keeping, employee personnel departments, pharmacy departments, and general overall organization of the entire field.

Designing, building, testing, maintaining, and supporting software and databases can bring about remarkable advances in the healthcare industry that is in dire need of information technology. Introducing effective databases, joint links and networks for data sharing and communication interface designs can create long lasting, sustainable relationships capable of addressing priority health problems of regional, national and global significance. Recent studies in bio-informatics and technology demonstrate current knowledge and practical skills, which will enable health care professionals to create and analyze their own databases.

Kemp, Angelopoulos and Gray (2000) believe that further developments in the ability to integrate and analyze the data held in existing heterogeneous data resources can lead to an increase in our understanding of biological functions at all levels. Additionally, bio-informatics researchers will be able to conduct secondary analyses on existing databases as a more effective and efficient alternative in order to generate relevant information at local and international levels. Therefore, accepting and adopting the concepts of database, data models, data warehousing, and other such concepts will certainly enhance the present health care industry.

2.4.1 General Technology (Management Information Systems)

"The inherent complexity both of care processes and of healthcare organizations has generated technological demands which, until recently, outstripped the capacity of hardware and software to capture and rationalize clinical services" (Goldsmith, 2005). A serious issue for many health care information systems/technology departments is a lack of technical competence in modern information technologies (Lorenzi and Riley, 1995). Change, and the way in which it is addressed in the technical design aspect of health care informatics systems can create numerous issues. "Technical realities, such as the lack of an enabling enterprise-level information technology (IT) integration infrastructure, the existence of legacy systems, and non-existence or embryonic enterprise-level IT services organizations, are delaying or frustrating the achievement of the desired configuration of shared service" (Covvey and Stumpf, 1999). These issues, while much more pronounced in the health care arena, are some of the same ones that affect IT and efficient delivery of health care services. Data are now dispersed and stored in various paper media across numerous platforms, and clinical errors in patient care, such as incorrect medical dosages, or even treatments, suggest automatic patient data processing could be beneficial.

Electronic communication could make available critical health information that is currently often unavailable. Clinical IT support is a key area in the current U.S. E-Health initiative to improve the integration of computers in health care. But clinical health care providers often resist IT support. This has been attributed either to medical conservatism, the difficulty of using IT or both. However, doctors and nurses often use complex medical equipment, and in health care laboratories they have readily accepted computer support. A more valid reason for IT resistance may be that clinical health care has unique requirements, specifically data confidentiality and data mobility. The difficulty of combining these criteria in a single IT product may explain why clinical health care lags considerably behind administrative health care in IT support.

2.4.2 Impact of Database Research

The impact of database research on this society, as it relates to important health issues and commercial applications, has accelerated at a rapid pace. Bio-informatics and biomedical engineering are very important active research areas that offer promising solutions to complex medical and biological problems, as well as practical applications for other professionals in industry and government. Today, scientific data is inevitably digital and is stored in a wide variety of formats in heterogeneous systems. Scientists need to access an integrated view of remote or local heterogeneous data sources with advanced data analyzing and visualization tools. Building a digital library for scientific data requires accessing and manipulating data extracted from flat files or documents retrieved from the Web.

There are several problems facing biomedical informatics researchers today: consistency and standardization of the terms, comments, code, and language used within multifaceted organizations. Biomedical informatics is a new and emerging field where research is carried on concurrently. One research group may use one type of syntax, and another group can use another. They may be speaking of the same terms. However, differences in their understanding may exist because of differences in the stated descriptions. This situation is where standardization becomes necessary for consistency across data sources. Another problem is the idea of transitive propagation error. This problem occurs when there are multiple databases that hold the same information. When there is a deletion or some sort of modification to be made to one database, this change must be reflected in the other databases holding the same information.

Other information that relies on the updated information must also be rectified. A patient may be prescribed medication X for a specific ailment. The patient experiences other symptoms, perhaps unrelated to the known ailment. At a subsequent doctor's visit, more tests show that the patient has another ailment that needs medication Y. A medical check needs to be performed to ensure that X can be taken with Y; if not, a safe substitute of X and or Y needs to be given. Currently this is all done manually. This situation demonstrates the problems of the non-existence of integrated databases where a health record for the patient with two doctors and two prescriptions resides (i.e. electronic prescribing).

Database interoperability is also an area that presents data inconsistency. Databases must have data integrity and must be data compatible, which would allow researchers the ability to compare, contrast, and integrate contents effectively and efficiently without constant data conflict. There must also be a level of transparency available when databases that are of a heterogeneous nature are queried and data analyzed for researchers. Reliability can be achieved with frequent back ups of data to guarantee that the system will be available. Additionally, databases within various research areas must employ some level of convention, or maintain similar standards, so that data can be exchanged and read without inconsistency.

2.4.3 Where Data Exist\Integration

Data analysis, data mining, creation of databases, and data integrity are becoming areas of interest in the growing medical/biological institutes today. As the number of records and data increases on a daily basis, storage, proper retrieval, and security bring about relevant concerns. Teamwork and collaborative efforts have been slow to materialize between informatics and biology and must be initiated. When these strategies are undertaken and adopted by professionals from different expert domains, a synergy results, whereby the optimal utilization of these resources can be obtained within these fields and the ultimate benefit becomes consistent patient health and recovery.

Two fundamental approaches for database integration exist: the data warehouse approach attempts to physically merge data sets from several source databases, whereas database federations simultaneously query source databases online. Life Science data require specialized handling, storage and query processing. Therefore, the data that are incorporated into these databases have more to do with knowledge management of healthcare data: that is, how this information will be managed (see Knowledge Management discussion in this chapter).

2.4.4 Knowledge Management

Previous sections of this document discussed the various components that encompass the management information systems for healthcare. In this section the technologies described show what is involved in organizational information requirements. New views of information are regarded as knowledge that has immense value to the firm and should be managed (McLeod and Schell, 2004).

Knowledge management is the tools, techniques, and strategies to retain, analyze, organize, improve, and share business expertise (Groff and Jones, 2004). For a healthcare organization or hospital, an example of the information that could be captured as part of the knowledge database would be as follows:

1. Patient information (must be secure and private)
2. Various dates of service and the medical practitioner that rendered care for each episode
3. Medications prescribed
4. Hospitalizations and treatment received
5. Insurance information
6. Dispersal of paper records that exist in many different places, and over the lifetime of a patient (e.g., upgrade to Electronic Health Records (EHR)).

Organizations determine what information is required to make business decisions when innovation and business agility are concerned. (Information and data are used as tools to inform or confuse one, where knowledge precedes an action.) Knowledge falls into two categories (Groff and Jones, 2003):

1. Tacit knowledge – Considered personal knowledge which is based on personal experiences, beliefs, perspective and values.
2. Explicit knowledge – Refers to tacit knowledge that has been documented.

Tacit knowledge has to be made explicit in order for it to be transferable and used in knowledgebase's. Relevance and perception play a large role in adoption; users have to perceive the system is relevant. There must be a fit between technology and task and between individual and organizational characteristics and the technology to get acceptance of knowledge management systems (Ericsson and Avdic, 2002). Coupled with this is the real threat of lack of security and privacy of a patient's health information which is currently a major issue for healthcare professionals and users of information technology. Therefore it is very important to evaluate alternative means of information communication systems to address solutions that are safe and secure to gain IT acceptance.

2.4.5 Computer Mediated Communication (Informatics)

In the ever-changing era of technological advancement, a preponderance of ways to solve business solutions exists. Computer Mediated Communication (CMC) has always been thought of as the way various communication media are used. CMC takes into consideration the various forms of interfacing that are used in day-to-day operations: face-to-face, email and various forms of computerization, such as mobile devices.

Traditionally, face-to-face meetings have been a central component of collaborative work in organizations. However, new computer and telecommunications technologies are permitting groups to conduct work in a variety of ways and thus to extend the concept of collaborative work beyond traditional face-to-face meetings. In the corporate arena, it is becoming increasingly commonplace for teams to "mix-and-match" interaction media over extended periods of time to accomplish their work (Cutosky, Tenebaum and Glicksman, 1996). Information technology and computer applications have had a tremendous impact upon the way people communicate, work, and conduct business and personal affairs. Professionals are now able to have meetings over the internet and never leave their homes or offices. They can take classes asynchronously, and conduct banking and financial transactions from a computer, PDA or wireless phone.

How a person communicates in personal and work environments is very sensitive. Individuals have spent many years mastering their favorite forms of communication, and through those communication processes they have realized their objectives, positions, and successes (Hiltz and Turoff, 1994). CMC tools have increased the modes of communication that are available and at the same time have given users of these tools more flexibility, which has cut costs for business and cut down on travel. As one might expect in an interdisciplinary and commercialized field (computer, information and communication systems), there now are a host of different names for systems that serve the common objective of using computers to facilitate human communications (Turoff, 1989, as cited in Hiltz and Turoff, 94). Among those in current use are,

- Computer-mediated communication systems (CMCS)
- Computer conferencing (CC)
- Electronic message systems (EMS), e-mail
- Collaborative systems (CS)
- Group decision support systems (GDSS)
- Coordination systems (CS)
- Cooperative systems (CS)
- Groupware, team ware (GW)
- Electronic meeting systems (EMS)
- Computer-supported cooperative work (CSCW)
- Hypertext (text with communications)

Hiltz and Turoff's extensive research and publications in the area of computer mediated communication have illustrated to the IS community numerous ways to successfully use computers and communications technology to facilitate and mediate group communications.

2.4.6 CMC Research Issues for Informatics

The Medical Informatics milieu and computer mediated communications have demonstrated that the current technology is not adequate. The health care industry has lacunae in its adoption of IT for some clinical areas, while its business area is functioning on a par with other business industries.

Health care is at a pivotal point where determinations need to be made regarding the way in which the U.S. healthcare delivery system is revamped. Can the clinical aspects of healthcare be aligned with business processes, while restructuring the way information technology can aid in the reduction of errors and cost? Evaluating existing technology can reveal that most industries have global links, where integrated data sharing is a focal point of day-to-day operations. Conducting the same type of evaluation of the healthcare industry determines that some areas virtually have no links to vital medical information.

Collaborative tools that are specific to researchers' and practitioners' requirements must be developed and integrated with new and existing computer technology which would allow the users to better service the health delivery system and the patient population. The literature cites several reasons for this predicament. Chaisson, Davidson, Kaplan and Kuperman (2004) state that the opportunities and challenges that confront healthcare and medical informatics research are evaluated by using solutions founded in IS theory and methods: identifying the requirements for healthcare and medical informatics (information technology) applications; the need for system and data interoperability: and the real concern about privacy and confidentiality of patient data (Hersh, 2004).

Listed below are the issues for linking various information technology frameworks that should be evaluated for the delivery of patient care in the U.S. medical environment.

2.5 Web\Internet Development

In previous sections of this document, an analysis of different alternatives that would bring about changes in the way information is accessed in the health care industry has been addressed. This section will evaluate patients' needs, for example, health care and monitoring the patient's health status. The various tools that encompass the unique system design required to ensure retrieval and transmission over a secure, reliable web-based delivery mechanism will be discussed. The repositories that hold the data that are accessed over the Internet/World-Wide-Web are referred to as databanks, databases, data warehouses and repositories (which were referred to in the Database section of the document). One of the main concerns regarding sharing information over the Internet will be security and privacy of classified medical information, referred to as a patient's protected health information (PHI).

Given the innovations and future developments, the Internet will not only become a tool that will make running a business easier, but it will make it easier for the clients as well as customers to connect in different ways. This advanced technology would allow for easy access to medical files, coupled with proper security for the health care provider when transmitting protected health information (PHI) that is mandated under HIPAA laws. "The Internet has great potential to improve health care by enhancing communications and improving access to information for care providers, patients, health plans, administrators, public health officials, biomedical researchers, and other health professionals. One obstacle to greater use of the Internet in health care is that health workers at all levels (physicians, care providers, administrators and information system staff) do not fully appreciate the ways in which the internet can improve the provision and administration of health care (Wiley-Patton, 2004, p. 7).

Web design can play a very important role in the way the health care system is viewed throughout the twenty-first century. With proper management and design, web sites could fulfill all the needs of the patient as well as the healthcare provider. There will be great advantages in the health care industry if a database site could be designed that would present a layout that is easy to navigate, where the information is simple to understand, and will provide all the information that the viewer would require.

Another way to incorporate the Internet into the health care system is to change the way the educational system for doctors and nurses is conducted. The process of analyzing medical information starts with the education of the healthcare providers. If medical school curricula were changed to include computer technology as part of their program, it would give healthcare providers the background in information technologies that they would need to keep up with the advancing healthcare industry. One of the main reasons for possible resistance to adoption of IT is due to providers not having been properly educated in the new technological trends that are evolving every day and required for their day-to-day vocation.

“Further, the users of healthcare technology in general are highly skilled professionals who have been trained in complex procedures for delivering patient care. In such a work system, the introduction of new technologies can often have unintended effects” (Sallas et al., 2007).

Another aspect is the uncertainty associated with a new technology. IT professionals must be able to reassure healthcare providers that they can trust the technology they have to interface with. Trust and confidentiality are paramount when sensitive data and information have to be used on a daily basis and transmitted over the Internet.

2.5.1 Extensible Markup Language (XML):

The emergence of Extensible Markup Language (XML) as a new standard for data representation and exchange on the World-Wide Web has created a new information revolution. Traditionally for each type of molecular sequence data there have been one or more key repositories. Each such repository or database has traditionally also used a proprietary data format and proprietary accession numbering for the deposition and retrieval of data. The concurrent maintenance of these mutually redundant archives has been problematic; there have been occasions on which novel or interesting findings have been missed due to the fact that sequences were present in only one of a set of mutually redundant databases. The complexities that exist in databases and the ways to look at potentially using them for new advances in the biomedical informatics area are as follows:

1. Problems with the management of data.
2. Need for interoperability among databases.
3. Meta-data and its issues
4. Use of modeling constructs such as object types, properties, domain values, relationships, relationship cardinality, function and inheritance.

The proliferation, diversity, and complexity of genome databases pose a significant challenge to the multi-database research community. Collections of biological data can be accessed via the World-Wide-Web. XML allows this data interchange on the Web making the Internet increasingly an important research tool for scientists working in biotechnology and the biological sciences.

Some on-line data resources provide search facilities to enable scientists to find items of interest in a particular database more easily. However, working interactively with an Internet browser is extremely limited when one wants to ask complex questions involving related data held at different locations and in different formats. One must formulate a series of data access requests, run these against the various databanks and databases, and then combine the results retrieved from the different sources. This can be both awkward and time consuming for the users, especially for those who are not computer literate. Moving the capabilities of existing standards into new web technologies will take some time, although a common infrastructure will enable easier integration of remote services (Wiederhold and Shortliffe, 2001).

2.5.2 Telemedicine

Telemedicine is a key aspect of health telemetrics connecting geographically dispersed health care facilities via videoconferencing, telecommunication, and digital medical diagnoses (Raghupathi and Tan, 2002). It is an optional treatment methodology that is accessed over the phone from physicians who are located remotely from the patient. Telemedicine's past experience can be used to benefit the current healthcare system regarding how to deal with patients who are not face-to-face, but are connected over the Internet. Using the Internet to provide patients with information at all times, as well as giving them training tools to learn the medical terminology so that they are able to understand what their physicians are talking about, will play a big part in removing the fear of going to the doctor. This type of dialog also helps patients to feel comfortable when describing their medical conditions. The two major benefits of this technology are lower cost of health care and online access to top medical experts worldwide; other benefits include medical education and intercontinental health care (Raghupathi and Tan, 2002).

2.5.3 Home Health Care

The Blueprint for Home Health Care Support via the Internet and the World Wide Web is a topic that can go hand-in-hand with telemedicine. Tarrant and Shannon put together a Blueprint for Home Health Care they envisioned based on a grant they received from the U.S. Department of Commerce. Glasheen (1994) indicated that if home care is to be truly effective as a cost controlling alternative to in-patient care, the same medical establishment that made reforms must guard against hospital re-entry for care receivers or stress illnesses in caregivers by providing a "seamless support system" in the home.

Because the cost of health care has grown, using home health care could lower the cost for patients who might not have sufficient healthcare coverage (Tarrant and Shannon, 1995). There are four primary objectives for the system:

1. To insure network access for all members of the community,
2. To provide training for information providers and users,
3. To identify local home health care needs, and
4. To locate or produce resources that satisfies those needs.

2.6 Theoretical Framework

2.6.1 Theoretical Framework Models

The frameworks that have been evaluated and determined to be feasible for this healthcare dissertation all used the TAM (Davis, 1989) and the Unified Model (Venkatesh, Morris, Davis and Davis, 2003) as a basis for the theories these researchers developed. The factors that the qualitative research explored were intention and usage of information technology in a healthcare setting.

2.6.2 Unified Model (Theory of Acceptance and Use of Technology (UTAUT))

The Technology Acceptance Model (TAM) has been the basis of robust research in most businesses for almost three decades (Davis, 1989). The TAM was established to answer the question regarding the acceptance or rejection of information technology by the user community. Davis (1989) evaluated empirical research from the "Theory of Reasoned Action (TRA)" model (Fishbein and Ajzan, 1975). TAM evaluated the constructs of perceived ease of use and perceived usefulness as it related to intention to use a software application. TAM is parsimonious, has a strong theoretical basis, has significant empirical support, and most important is IT specific. It has therefore become a dominant model for investigating technology acceptance by users (Hu, Chau, Sheng and Tam, 1999).

"Next, a unified model, called the Unified Theory of Acceptance and Use of Technology (UTAUT/TAM2), was formulated, with four core determinants of intention and usage, and up to four moderators of key relationships" (Venkatesh et al., 2003). See

Figure 2.5 on the next page. A breakdown of the model is listed below where the first five constructs pertain to Venkatesh et al., (2003):

- Performance Expectancy – belief that using the system will improve job performance.
  - Perceived usefulness, extrinsic motivation, job-fit, relative advantage and outcome expectations.

- Effort Expectancy – degree of ease with the usage of the system.
  - Perceived ease of use, complexity and ease of use.

- Social Influence – individual behavior influenced by how individuals believe others will view them if they use the system.
  - Behavioral intentions represented as subjective norm, social factors and image.

- Facilitating Conditions – individual belief that the organization and technical infrastructure support the use of the system.
  - Perceived behavioral control, facilitating conditions and compatibility.

- Behavioral Intentions –significant positive influence on technology usage.

- Gender, Age, Experience and Voluntariness constructs are the four moderators of key relationships.

TAM and TAM2 have made a significant contribution to the empirical literature and research community. These advances have made possible the following theoretical frameworks that are being evaluated for this dissertation to come to fruition.

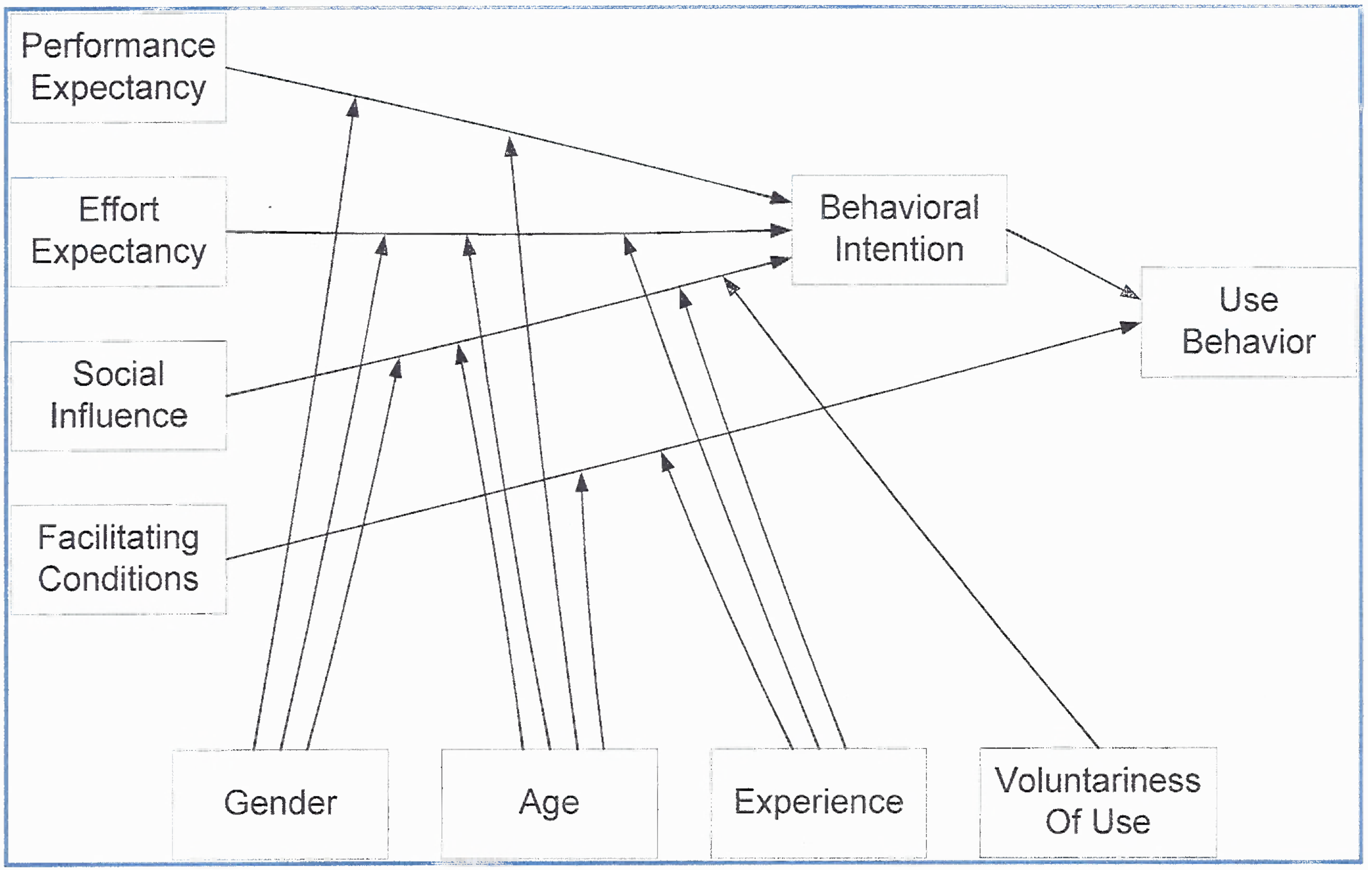


Figure 2.5: Unified Model Adapted from Venkatesh, Morris, Davis and Davis, (2003).

2.6.3 Healthcare-IT-Adoption Model

Motivated to understand the adoption behaviors of healthcare professionals, Wiley-Patton and Malloy (2004) developed an IT adoption model that fosters IT acceptance and clinical integration (Wiley-Patton and Malloy, 2004). This theoretical model is being pilot tested on the computerized physician order entry system (CPOE) at Our Lady of the Lake Regional Medical Center (OLOL) and Louisiana State University Health Science Center (LSUHSC). Wiley-Patton (2002) and Malloy (2004) reviewed prior research in the Information Systems community and determined that physicians have a low utilization rate for information technology applications, even though there is a great need in their clinical practices. The rate of medical errors due to death, injury and medication has not caused physicians to use Internet-based applications either. Wiley-Patton and Malloy (2004) state "lack of integration between clinical processes and information technology" and "the problem of healthcare professionals' resistance towards the adoption and use of information systems and information management technologies" contribute to the current healthcare quandary. Additionally, research conducted to date has been specific to organizations and professionals who are not a part of the healthcare community, which has diverse requirements. Figure 2.3 depicts the Healthcare-IT-Adoption Model. This framework "pursues the understanding of healthcare professionals' intentions to adopt IT by integrating social network theory, social influence and persuasion theory with constructs from existing IT adoption models" (Wiley-Patton and Malloy, 2004).

This framework is specifically designed for the health care industry where current evaluation methods were non-existent. Current IS research has not looked at adoption/diffusion theory (Rogers, 2003) of IT in healthcare in such a rich and dynamic way. Wiley-Patton and Malloy have moved into an area of research that typically did not include physicians and the way they embrace a new IT innovation in a clinical environment. Consequently, subjects involved in IT adoption/diffusion studies have traditionally been corporate personnel or students, etc., not physicians and the ancillary workers that constitute a hospital, medical practice and/or the treatment of illnesses. "IS researchers have long sought to understand factors that influence IT acceptance behavior as well as to identify why people do not adopt and use systems that could potentially increase their productivity, and in this case, improve the quality of healthcare" (Wiley-Patton and Malloy, 2004). These researchers have determined numerous factors related to the inconsistent nature of the adoption of IT, including but not limited to 1) Inhibitors that influence clinical IT adoption, diffusion and use; 2) IS research to fully understand the unique IT needs of healthcare professionals; 3) Theoretical model deployed to evaluate social network theory, persuasion and influence against the existing IT adoption theory, to also facilitate and understand barriers that foster reduction of IT adoption and usage. This theory appears to lend itself to answering questions that address and identify barriers that inhibit successful implementation and IT adoption in the healthcare milieu. The Technology Acceptance Models (TAM) and the Unified Model for usage intention, behavior and social influence constructs (Venkatesh and Davis, 1999; Venkatesh, 2000; Venkatesh et al., 2003) were evaluated, as well as several others which did not look at the healthcare population.

Next, Cenfetelli's framework further expands the inhibitors of usage for IT in the following section.

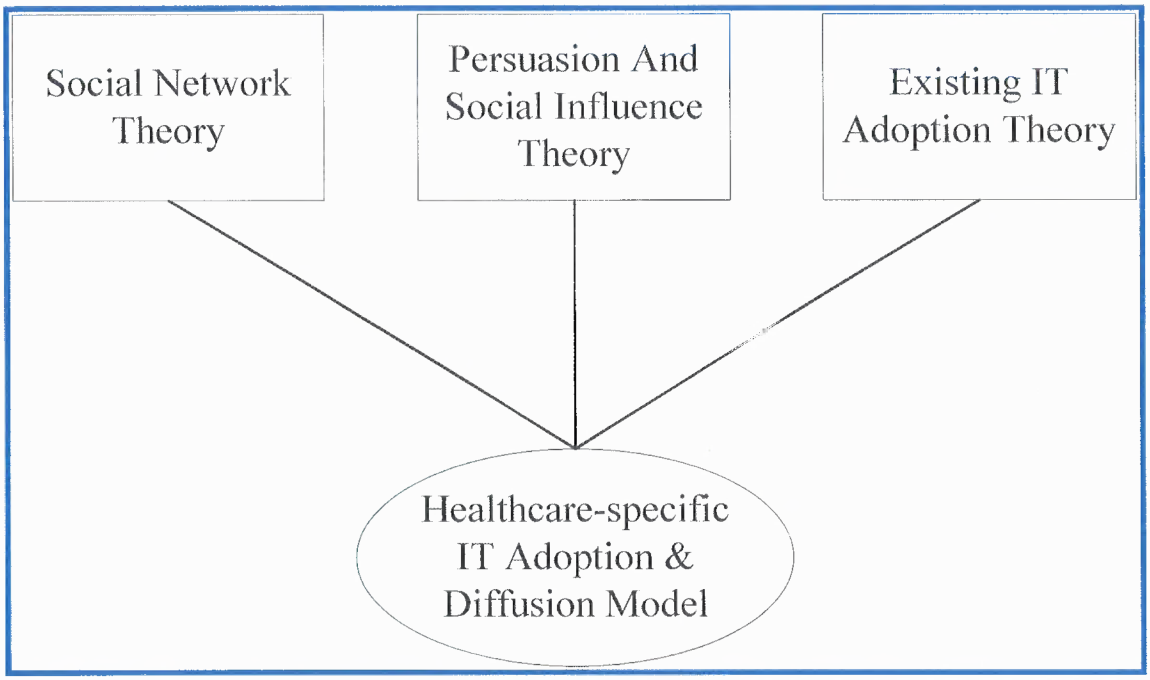


Figure 2.6: Healthcare-IT-Adoption Model
Adapted from Wiley-Patton and Malloy (2004).

2.6.4 Inhibitors of Usage Research Model

Why systems fail and what factors in research have been offered to quantify failure is what prompted the investigation that seeks to evaluate system failure. While we all know of systems that have failed, researchers have been reluctant to extensively investigate failure, resistance to system usage, or dissuading usage. There are numerous books and publications about the diffusion of innovations (Rogers, 2003, 1995), attitude (Venkatesh, 2000, 1999; Venkatesh et al., 2003), perception (Brown and Swartz, 1989), intention (Cenfetelli, (2004), usage (Davis, 1989; Whitworth et al., 2003) and functionality and how to evaluate systems adoption, based on various frameworks. However, we are aware that not all systems are successful; some fail and in some cases we have partial failures or partial successes (Dewan, et al., 2004; Kaplan, 2004; Lorenzi and Riley 1995), Cenfetelli (2004) cited Venkatesh and Brown saying "there may exist barriers to use that act to solely inhibit use in their presence but do not encourage use in their absence." The lack of system acceptance or perceived usefulness, whether right or wrong, can contribute to system rejection or inhibit usage. "Users who perceive a system to be 'flexible' tend to adopt that system whereas systems perceived to be constraining are not adopted" (Cenfetelli, 2004). Inhibitors play a role in whether a person becomes a stakeholder in a new innovation. One's belief about a system can be biased and his or her level of acceptance will negatively inhibit usage of the system. Ease of use and usefulness constructs derived from the technology acceptance model measure system beliefs, whereas enabling beliefs that cause one to use the system are derived from user satisfaction literature. As cited in Cenfetelli (2004), there are four paradigms incorporated into this model: technology acceptance (TAM, Davis, 1989); user satisfaction (DeLone and McLean, 2003), diffusion of innovation (DOI, Rogers, 2003, 1995); and service quality (DeLone and Mclean 2003, Parasuarman et al., 1988, 1985). The key to the TAM's position in IS research lies within the constructs of influence of attitudes and intention for usage. The four paradigms that were the foundation for research in the area of inhibitors are all based on the TAM constructs mentioned above.

The Inhibitors of Usage Research model, Figure 2.7, unites the four paradigms (TAM constructs) showing how beliefs about use and usefulness are separate from external beliefs about the system. In this model inhibitors and their influence on usage will be identified as they relate to system, information and service quality. There are two roles that inhibitors play in discouraging usage: they act directly on beliefs about the consequences of use, and they bias the positively oriented and symmetrically acting beliefs of the system as an object: system, information and service quality (Cenfetelli, 2004). The inhibitor of usage model was chosen based on its ability to look at the downside, of barriers to usage of an innovation in IT. Lastly, the Web of Systems Performance (WOSP) model will be discussed. The researcher will consider a different aspect of the WOSP model which incorporated the unique requirements of the healthcare environment, i.e., data mobility, security and confidentiality for potential clinical healthcare IT development.

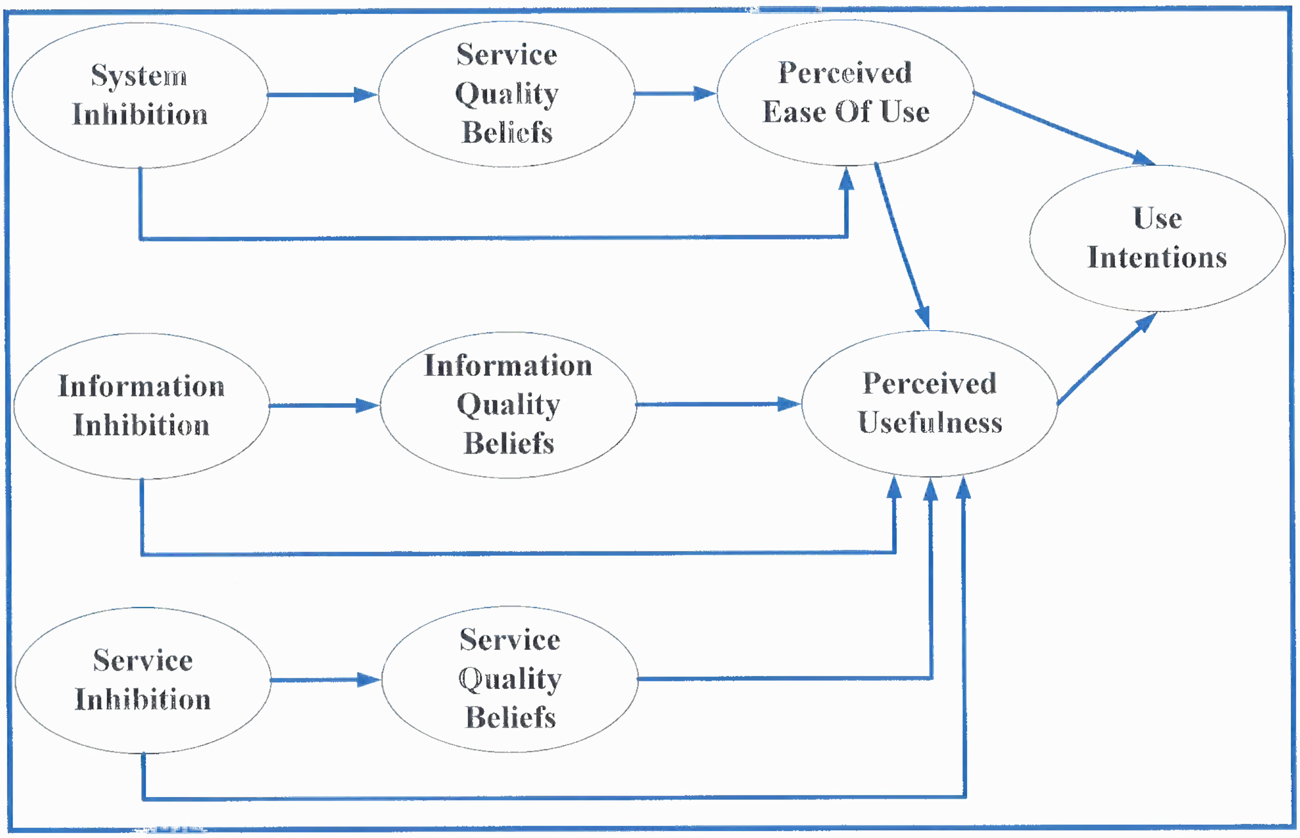


Figure 2.7: Inhibitors of Usage Research Model
Adapted from Cenfetelli, (2004).

2.6.5 Web of System Performance (WOSP)

The Web of System Performance is a combination of factors that are tied together to form an integrated approach for development. The WOSP model (see Figure 2.8) extends and integrates previous theories, including TAM, the general security model, and non-functional requirements research (Whitworth and Zaic, 2003). None of these constructs is new; however, the constructs in this model demonstrate a balanced perspective that is new to the IS field. The WOSP framework utilizes four opportunity-increasing dimensions that are active (extendibility, flexibility, openness, connectivity) and four failure–avoiding dimensions that are passive (security, reliability, privacy, usability), listed below in Table 2.2 (Whitworth, Cheikna and Whitworth, 2006: Mahinda, 2008).

System parameters interact within the WOSP framework and system performance is balanced between these parameters. Of these eight performance goals, flexibility, security, privacy and mobility are issues that are very important to clinical healthcare and information technology initiatives. The WOSP model supports the risk associated with security and recognizes availability as ease of use, or usability, but sees both usability and privacy as distinct from security (Whitworth and Zaic, 2003).

Table 2.2: Eight Performance Goals in the WOSP Model

Boundary – Defines System Entry	1. Extendibility – To enable useful entry 2. Security – To deny harmful entry
Internal Structure – Controls And Sustains	1. Flexibility – To accommodate external change Reliability – To accommodate internal change
Effector – Changes The Environment	1. Functionality – To maximize external effects 2. Usability – To maximize internal effort
Receptor – Senses The Environment	1. Connectivity – To enable meaning exchange 2. Privacy – To limit meaning exchange

What does Figure 2.8 represent? In the web of system performance the:

- ***Web Area*** represents system performance in general so a bigger area means a greater system performance potential.
- ***Web Shape*** represents the goal criterion weights, which vary with the environment, e.g. a threat environment may mean security has more weight.
- ***Web lines*** represent ***goal tensions***, imagined as connecting rubber bands that can pull back one performance dimension as another increases.

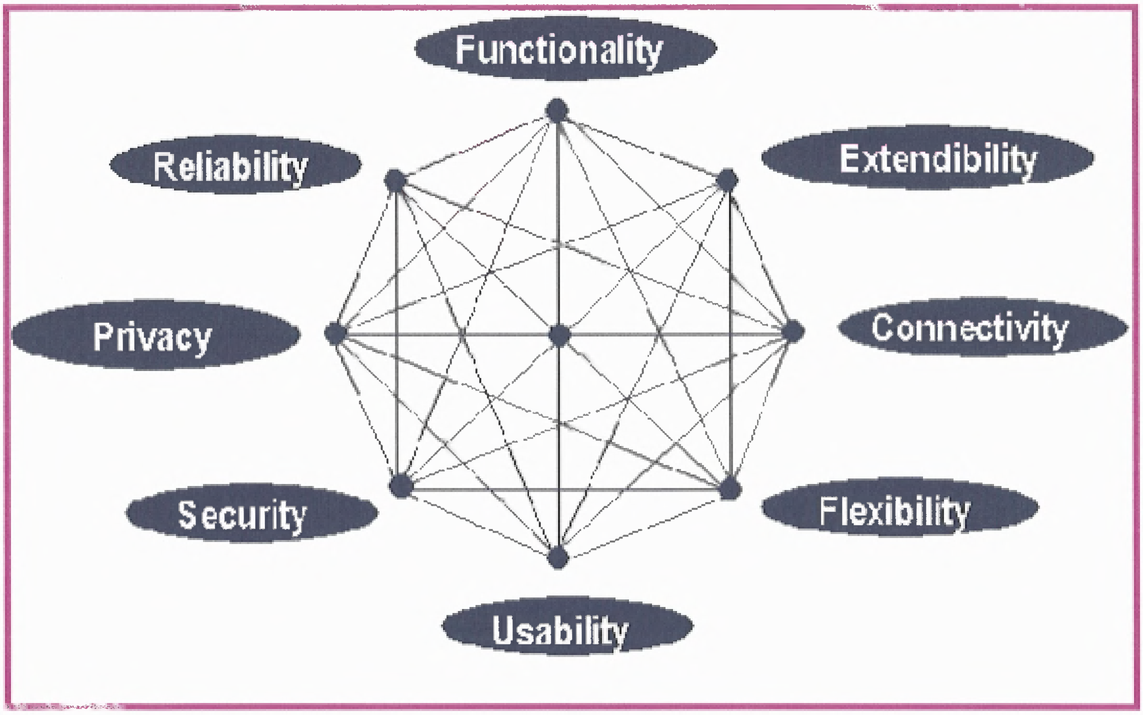


Figure 2.8: Web of System Performance (WOSP)
Adapted from Whitworth and Zaic, (2003).

Clinical healthcare and medical informatics systems must be designed to include the constructs that keep threats from penetrating their IT environment. The WOSP model separates availability (usability) from security (resisting attack), and handling internal failure (reliability) from preventing hostile entry (security) (Whitworth, Fjermestad and Mahinda, 2005). A study of attitudes to browser use found privacy and security were rated higher than functionality and usability (Mahinda and Whitworth, 2005). Results from this study have created a framework for Clinical IT in the current research, which extends the privacy and security constructs. The research direction taken thus far is based on the multiple issues facing health care and information technology initiatives.

The research posits a perceptual gap between what clinical providers and clinical staff require of IT support and what IT professionals perceive as clinical IT requirements (unique). Additionally, the multiple constraints clinical health care is addressing can be integrated into a framework (WOSP) that can help to better understand poor IT acceptance and thus reduce it. Thus, applying the WOSP model to the healthcare setting suggests (Hare, Whitworth, Deek and Norris, 2006):

1. The clients of healthcare are often in poor health, so clinical healthcare providers often have to move to the client's location, e.g. a patient's bedside. Consequently any IT support must be mobile, and in emergency cases where time is an issue, highly mobile (easy to move or relocate).

2. Healthcare data can be extraordinarily sensitive, as revealing patient information can affect careers, marriages, family relations and job tenure and prospects. People coming into a healthcare setting, e.g. with sexually transmitted diseases, expect the utmost privacy regarding their personal health data, and without that, may not come at all.

3. National privacy standards have been mandated under the Health Insurance Portability and Accountability Act of 1996 (HIPAA). Although there are numerous parts to this legislation, this research is concerned with Privacy, Security and Electronic Transaction and Code Sets Rules that mandate protection and privacy of certain individually identifiable health data, referred to as protected health information (PHI) (www.hipaa.org). Clinical healthcare providers have unique requirements for mobile IT tools which will grant them access to PHI that will be in the form of E-Records, E-Prescriptions, Telemedicine etc,. Therefore, in order for the providers to adopt or become compliant with HIPAA regulations,

IT innovations must adhere to the constructs that keep private data confidential and secure, as well as address patients' individual requirements.

In the infancy of software development, designers held functionality (what the system does to the world) as the primary goal of software development. This is because at that time, software was just a tool. Current information technology systems have become more complex, but also less passive and more active in their own right (Whitworth, Cheikna and Whitworth, 2006). Table 2.3 shows a systems view of clinical IT and the WOSP framework. And Table 2.4 clinical performance. Next, two WOSP figures: Figure 2.9 depicts the right-most parameters that system designers prefer; Figure 2.10 depicts the left-most parameters that are a preference for healthcare professions.

Table 2. 3: Systems View of Clinical IT Utilizing the WOSP Framework

Systems Elements	**WOSP Constructs/Goals**
Effector – System Utility	1. Functionality – Maximize system utility 2. Usability – Reduce system complexity
Boundary – Systems Boundaries	1. Extendibility – Enable boundary changes 2. Security – Deny boundary changes
Receptor – Systems Interconnections	1. Connectivity – Enable system interconnections 2. Privacy – Limit system interconnections
Internal Structure – System Changes	1. Flexibility – Allow desirable changes 2. Reliability – Deny undesirable changes

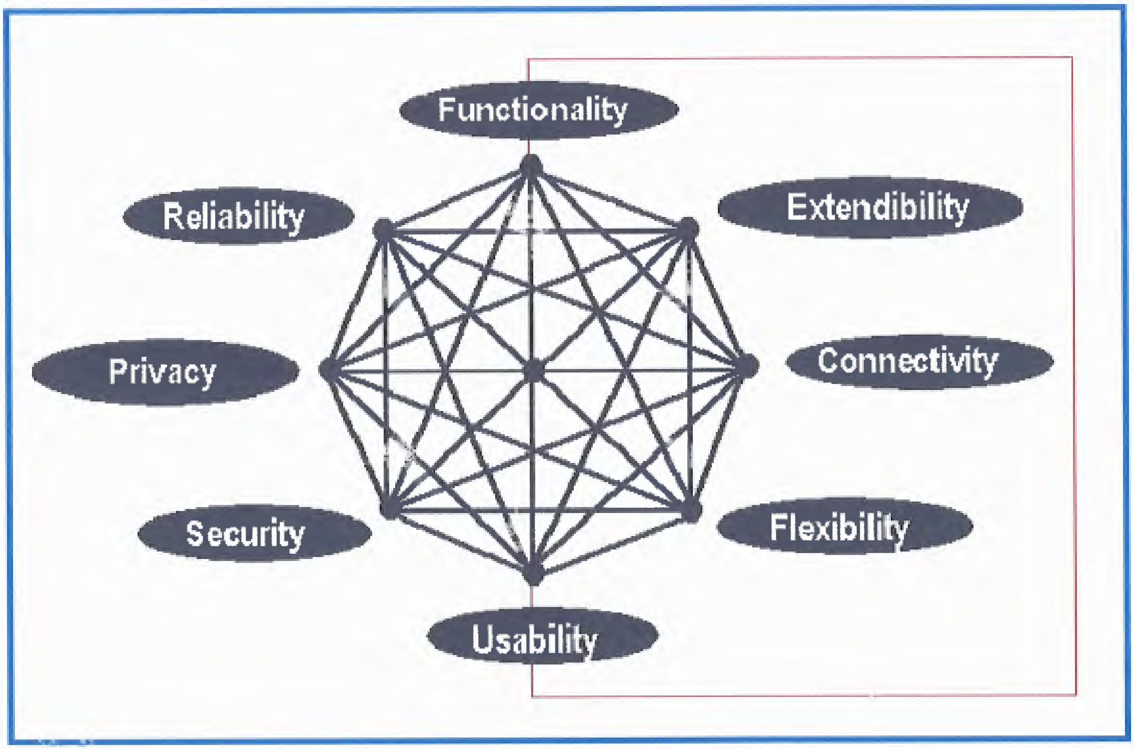


Figure 2. 9: WOSP - System designers prefer systems with right-most parameters.

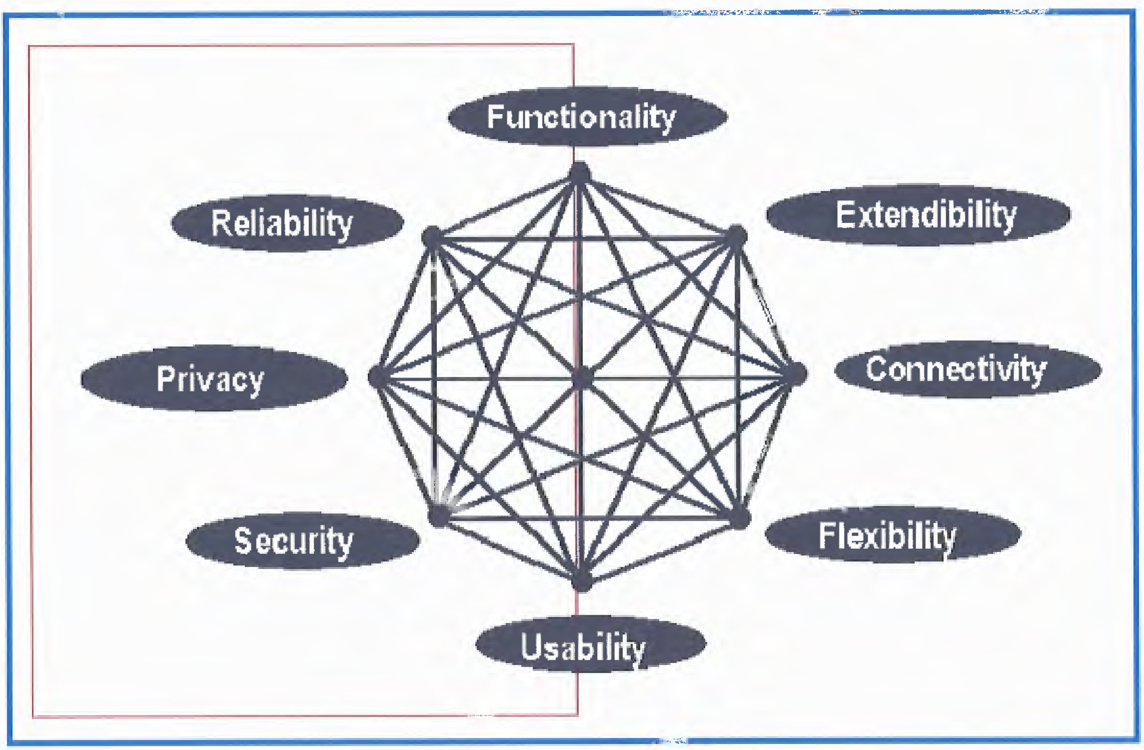


Figure 2.10: WOSP – Healthcare Professionals prefer systems with left-most parameters.

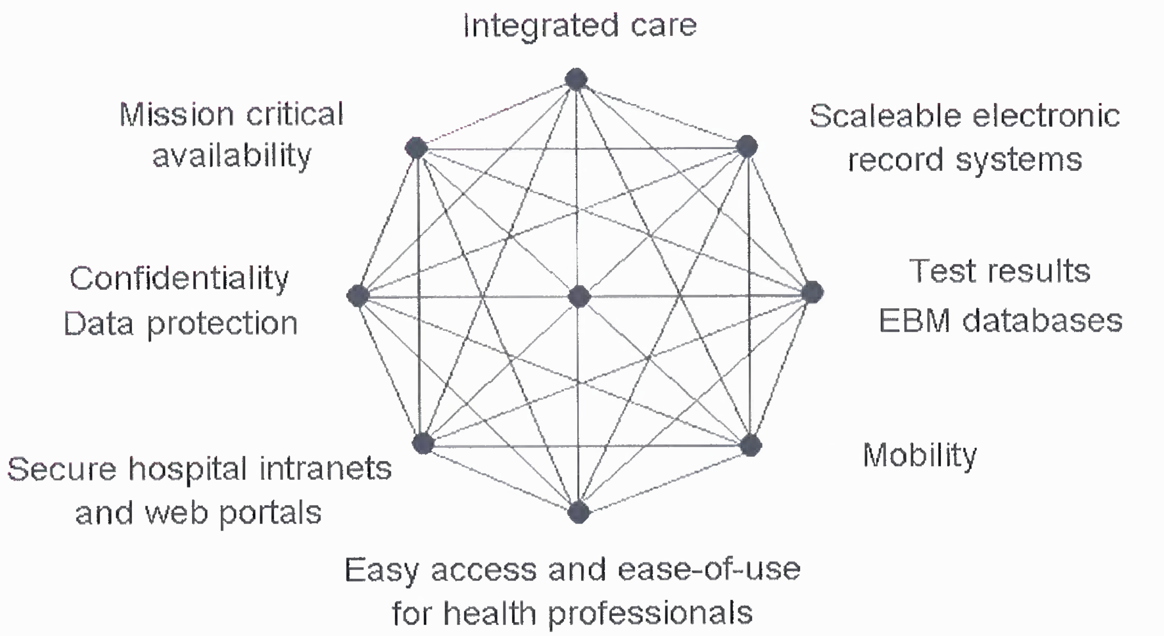


Figure 2.11: WOSP and Clinical IT Performance, Hare, Whitworth, Deek and Norris (2006).

Table 2.4: WOSP and Clinical IT Performance

WOSP System Elements	WOSP Constructs	Clinical IT And WOSP Constructs
Effector – System Utility	1. Functionality 2. Usability	1. Integrated Care 2. Easy access and ease-of-use for health professionals
Boundary – Systems Boundaries	1. Extendibility 2. Security	1. Scalable Electronic Records System 2. Secure hospital intranets and web portals
Receptor – Systems Interconnections	1. Connectivity 2. Privacy	1. Test results and EBM databases 2. Confidentiality data protection
Internal Structure – Systems Changes	1. Flexibility 2.Reliability	1. Mobility 2. Mission Critical Availability

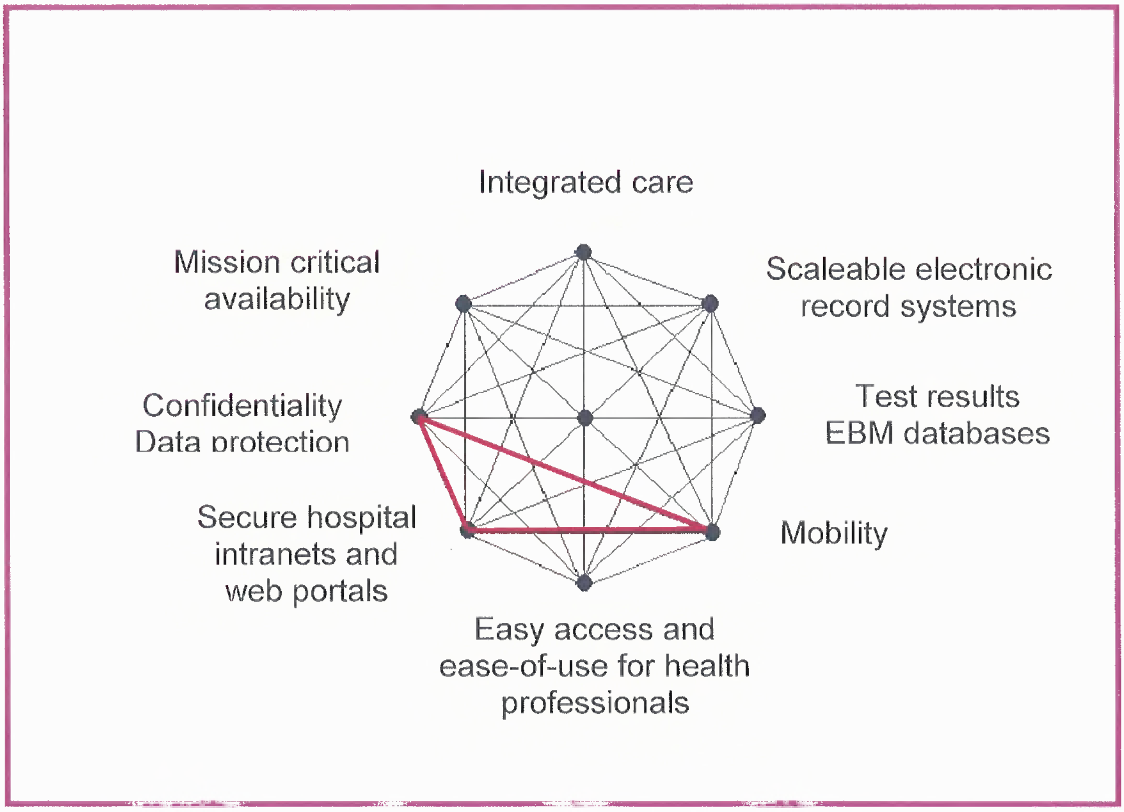


Figure 2.12: WOSP and Mobile IT Performance, Hare, Whitworth, Deek and Norris (2006).

- Information technology mobility, security and privacy are critical considerations for practitioner adoption.
- Increased availability of wireless and mobile computing render wireless networks insecure.
- A major realignment of IT services is necessary for adoption in the clinical healthcare setting to occur.

The theoretical frameworks that have been presented in the proceeding pages have all derived from the Technology Acceptance Model (TAM) which has added considerable empirical literature to the field of IS. Each of the models discussed has been presented because of the specified aspect that is contributing to the formation of this research.

Searching the literature was important to see what fields have benefited from the introduction of this work and how it has advanced empirical research in the field. Table 2.5 chronologically depicts some of the research that has been done using constructs and theories from the TAM model. Within the last five years these theories have expanded into the healthcare milieu and this is where the interest has evolved. Table 2.6 has been adapted to show the exact topics, technology and studies that have been conducted. This table (2.6) includes dissertations and publications that have been cited.

The Web of System Performance shows potential for advancing research in the field of clinical healthcare and information technology. Whitworth and Zaic (2003) state "the WOSP model provides a useful framework for new technology". Research conducted by Mahinda and Whitworth (2005) validated performance requirements when they studied attitudes to browser use. This browser research determined that users actually consider all 8 performance requirements and rated security and privacy higher than usability. Six of the eight constructs were proven to be significant with connectivity and flexibility not being totally significant (Mahinda and Whitworth, 2005).

Results from Mahinda and Whitworth study (2005) validated the WOSP framework that extends privacy and security constructs that are required in clinical IT; which leads to the research question stated in chapter 3.

2.6.6 TAM Research

Table 2.5: Technology Acceptance Research Summary, Adapted from Hauze, G.W., (2004, pp. 100-101).

Year	Author	Study Population	Technology Studied
1986	Davis	New end users	Information Systems
1989	Davis	MBA Students	Word Processing
	Davis et al.,	a) IBM Lab Employees b) MBA Students	a) E-mail, file editor b) E-mail, file editor
1991	Mathieson	College Students	Spreadsheet
	Moore & Benbasat	Company Employees	Personal work stations
1992	Davis et al.,	MBA Students	Word processing graphics
1993	Davis	Company Employees	E-mail, text editor
1995	Chin & Todd,		E-mail, text editor
	Igbaria et al.,	Working MBA Students	Microcomputer usage
	Taylor & Todd	Business School Students	Computing Services
1996	Chau	Company Employees	Word Processing, Spreadsheet
	Venkatesh & Davis	a) MBA Students b) College Students c) Working MBA Students	a) Graphics b) WordPerfect/Lotus c) E-mail, Gopher
1997	Agarwal & Prasad	Working MBA Students	Internet
	Gefen & Straub	Airline Professionals	E-mail
	Igbaria et al.,	Small Firm Employees	Personal Computing
1998	Agarwal & Prasad	Fortune 100 Employees	Internet
	Doll et al.,	College Students	Office Products
1999	Agarwal & Prasad	Working MBA Students	Internet
	Hu et al.,	Physicians	Telemedicine
	Karahanna et al.,	Company Employees	Windows 3.1
	Lucas & Spitler	Investment Brokers	Workstations
2000	Park	Physicians	Personal Digital Assistants
	Venkatesh & Davis	a) Floor Supervisors b) Financial Services c) Accounting Services d) International Banking	a) Proprietary Application b) Windows Applications c) Account Management d) Stock Profiling
2001	Johnson	Pediatricians	Pediatrics Technology
2002	Fisher	Pediatricians	Patient Management
	Venkatesh et al.,		Decision Making
	Wiley-Patton	Pediatricians	Internet-Based Application
2003	Aldosari	Physicians	Medical Information Systems

Table 2.6 Prior Healthcare Information Technology Research

Author(s)/Date/Publication	Document Title	Study/Technology
Aldosari, B. (2003) Dissertation	Factors affecting physicians' attitudes about the medical Information System usage and acceptance through the mandated implementation of Integrated medical information system at Saudi Arabia National Guard Health System: A modified technology acceptance model.	- Physicians - Medical Information System
Ash, J.S.,(1997) Dissertation	Factors for information technology diffusion and infusion in the Health Sciences Organizations : A systems approach	- Academic Health Science Centers - Computer-Based Patient Records (CPR) - E-Mail
Chau, P. Y. & Hu, P.J. (2002) Journal Of Management Information Systems, 18, 4, pgs. 191-229.	Examining a model of Information Technology Acceptance by individual professionals : An exploratory study.	-Physicians In Hong Kong - Telemedicine Technology Acceptance
Fisher, M.E. (2003) Dissertation	Using the technology acceptance model to measure pediatrician acceptance of practice management information systems.	- Pediatrics - Patient Management Information System
Hauze, G.W. (2004) Dissertation	Influence of privacy regulation on the acceptance of e-business applications by healthcare providers in Arizona.	- Physicians, Dentist and Chiropractors - Privacy regulations and confidentiality influence on e-business healthcare applications.
Hu, P.J. (1998) Dissertation	Management of telemedicine technology in healthcare organization: technology acceptance, adoption, evaluation, and their implications.	- Physicians - Telemedicine technology
Johnson (2001)		-Pediatricians - Pediatrics Technology
Park, J. (2000) Dissertation	Physicians' acceptance of information technology (IT) across IT innovation diffusion status	- Physicians - Information Technology and innovation diffusion.
Sobel, M.G., Alverson, M. & Lei, D. (1999) Topics In Health Information Management, 19, 4, pgs. 1-18.	Barriers to the adoption of computerized technology in health care systems.	- Barriers to adoption - Computerized technology in health care systems.
Wiley-Patton, S. (2002) Dissertation	A test of the extended technology acceptance model for understanding the Internet adoption behavior of physicians.	- Pediatricians - Internet-Based Application

2.7 Initial Research Direction

The concept for undertaking this research was to find out "why" clinical healthcare was not realizing all the technical benefits for a system that handles life or death issues daily. The discovery was that there appears to be a disparity between the administrative and clinical sides of health care. Traditionally the systems that support hospital management information systems have been based on financial systems which generate monetary gain for fiscal solvency. The following are considered administrative systems: general accounting (payables and receivables), payroll, patient billing, census management, and the operational needs of the hospital or healthcare facility. However, the clinical side of healthcare is patient intensive or human-centered. Some clinical departments, like radiology and laser assisted procedures for surgery and treatment, have had the luxury of information technology, but other clinical areas lag behind. Stakeholders face other issues that can be viewed as barriers to technology adoption. Venkatesh and Brown (2001, p. 91) state that "critical barriers that attribute to non-adoption (rejection) are: rapid change, high cost, and lack of knowledge," which create additional divergence or inhibitors to information technology solutions for clinical healthcare.

The perspective that each side brings to the table regarding what is required for efficient delivery of services contributes to the variations in systems designed, developed, implemented and adopted. Consequently, the unique aspect of clinical healthcare systems presents a challenge for the developers of information technology applications and drives the research question.

2.8 Research Question

Why Has Clinical Healthcare Been Slower To Adopt Information Technology Than Other Healthcare Milieus?

- The independent variable is "the perception of the gap between Information Technology Professionals and Clinical Healthcare Providers". This perception is reflected on the left side of the WOSP model in Figure 2.10 for IT professionals. Figure 2.9 shows the perception of the gap on the right side for Clinical Healthcare providers and professionals.
- The dependent variable will be "Information Technology Adoption in Clinical Healthcare".
- While the literature reviewed indicated there is a contrast within the area, the question will seek to answer:
  - Is there a perceptional gap between Information Technology Professionals and Clinical Healthcare Providers?
  - How are my findings going to contribute to identifying and closing the gap?
- These are a few issues that have been identified in the literature review:
  - Critical success factors can be categorized into two areas (Cenfetelli, 2004):
    - Inhibitors – can stop IT adoption.
    - Facilitators – can improve IT adoption.
  - Lack of integration between clinical processes and Information Technology (Wiley-Patton and Malloy, 2004).

- Results from Mahinda and Whitworth study (2005) validated the WOSP framework that extends privacy and security constructs that are required in clinical IT.

The final study (III) built upon finds from pilot studies I and II that confirm a disparity; minor adjustments were made to the survey constructs (Appendix C.1 – C.3) before expanding the survey constructs for the third study (Appendix C.4 – C.5). That is, “Why has clinical healthcare not adopted IT as has administrative healthcare”?

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter gives a brief overview of the literature reviewed in chapter 2 and the issues in the healthcare industry which motivated the research studies undertaken in this dissertation.

The literature review presented has addressed the issues that are confronting the health care milieu and indicates alternative solutions for restructuring the fractured and unwired system. Healthcare information systems have historically been administrative systems, with responsibility for financial viability of the healthcare organization. Currently there exists a disparity in the level of automation that has taken place on the administrative versus the clinical side of healthcare. The major issues that impact information technology in clinical healthcare are legislative mandates for patient privacy, confidentiality, and security; interoperability, which creates data complexity when new clinical applications are developed and programmed for integration with existing software; and the way that data need to be communicated across platforms for patient health status: testing, lab work and prescriptions. The research posits that the most important reason for IT resistance may be the unique requirements of clinical healthcare, specifically data confidentiality and data mobility. The difficulty of combining these criteria in a single IT product may explain why clinical healthcare lags considerably behind administrative health care in IT support.

The clinical healthcare milieu has embarked upon an era that is requiring providers and practitioners to enter into the technological arena. There has been a lag between Information Technology and Clinical Healthcare application; the systems that have traditionally been developed have been business applications that generate finances that contribute to the bottom line for overall business processes. However, with escalating costs and the number of medical errors and deaths associated with quality in delivering medical care, the government has stepped in with federal legislation and mandates for health information technology (HIT) (Institute of Medicine, 2001, 2000) (HIPAA). These issues have been discussed in the problem statement of this dissertation.

The researcher used literature reviewed as a starting point to identifying lags in what is being developed for clinical healthcare providers by information technology departments and began conducting Pilot studies to determine:

- **Pilot Study I** – What is the diffusion of information technology in clinical healthcare organizations?
- **Pilot Study II** - What information technology tools are required by clinical healthcare providers as they conduct their daily tasks and deliver quality patient care?
- **Final Study III** - What is the perception of information technology professionals and clinical healthcare providers regarding IT requirements for delivery of patient care?

3.2 Research Introduction

There are three studies associated with this dissertation that span from August 2003 through May 30, 2007 and the overview of each is listed below. Figure 3.13 is a graphic depiction of the studies, data collection and associated participants.

The preliminary pilot study investigated non-monetary factors that affect information technology adoption in clinical health care. It was conducted to determine the level of acceptance, resistance and change associated with the introduction of information technology (IT) into operating departments in hospitals and health care organizations.

Technologically speaking, we are in an environment where information is transmitted at lightening speed, and information overload is an everyday occurrence. Coupled with this is the way information technology has an impact on our lives, and how we react to using it to accomplish tasks in the workplace. Additionally, how we process this information determines the way we interface with the procedures that are inherently used when we interface with information technology in our hospital and health care organizational departments.

The studies conducted enabled this researcher the ability to identify barriers to information technology adoption in clinical healthcare. This identification was revealed from studies I through III, where data was collection and analysis at the following sites (Figure 3.13). Study I and II are considered preliminary piloted data which supplied outstanding issues that were written up as questions in Study III. The research methodology and data collection had minor changes for Study III.

1st. Study

Major urban teaching hospital with medical and dental school affiliation:

- One domain
- Ob/Gyn clinic with 18 participant

2nd. Study

Combination of clinical healthcare providers and information technology professionals:

- Physicians, nurses, clinical providers of care (support staff), IT, Clinical IT,
- Private physician practice
- Networked hospital system
- IT department within medical/dental school
- 10 participants

3rd. Study

Cross domains that include:

- Networked hospital system
- Teaching hospital with medical/dental school affiliation
- Clinics
- Outpatient facility (within a hospital system)
- Individual physicians (within a hospital system)
- 125 – 150 participants (contacted and 86 analyzed)

3. 2.1 Research Studies

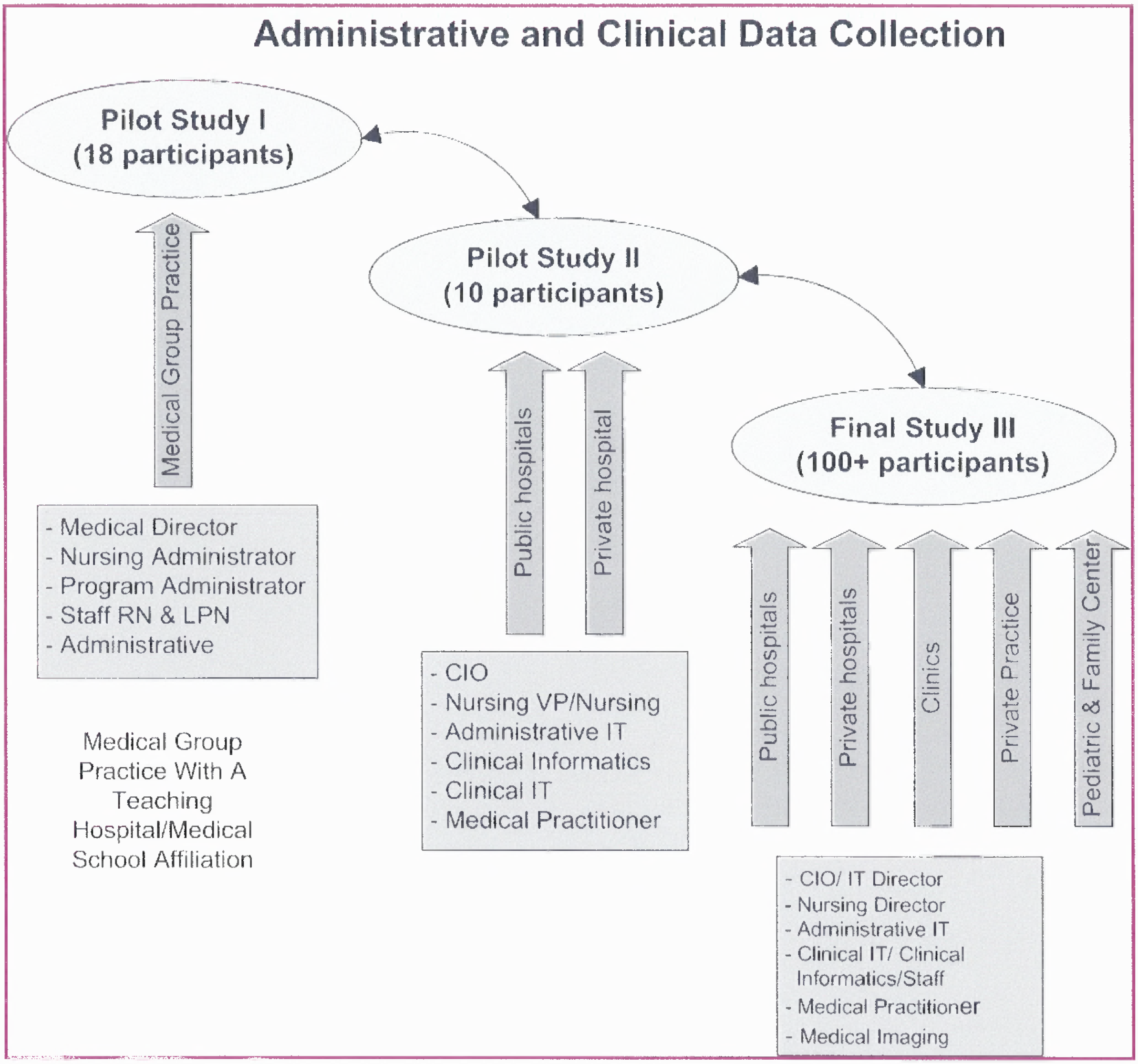


Figure 3.13 Research Studies.

3.2.2 Pilot Study I

The preliminary pilot study investigated non-monetary factors that affect information technology adoption in clinical health care. Descriptive statistics from this study are in Appendices F.1 – F.1.5.

This dissertation research is based on three studies (2 pilots and a final study) associated with the availability of information technology systems in clinical healthcare environments and the perceptions of professionals in these two areas when diffusing innovative technology in a medical setting. The final study (III) will explore the perception gap between information technology (IT) departments (professionals) and clinical healthcare providers' (Physicians) other healthcare providers (non-physicians). Another aspect of this research is the availability of information technology systems in clinical environments, and the perceptions of professionals in these domains when diffusing innovative technology in a clinical setting.

3.2.3 Health Care Framework

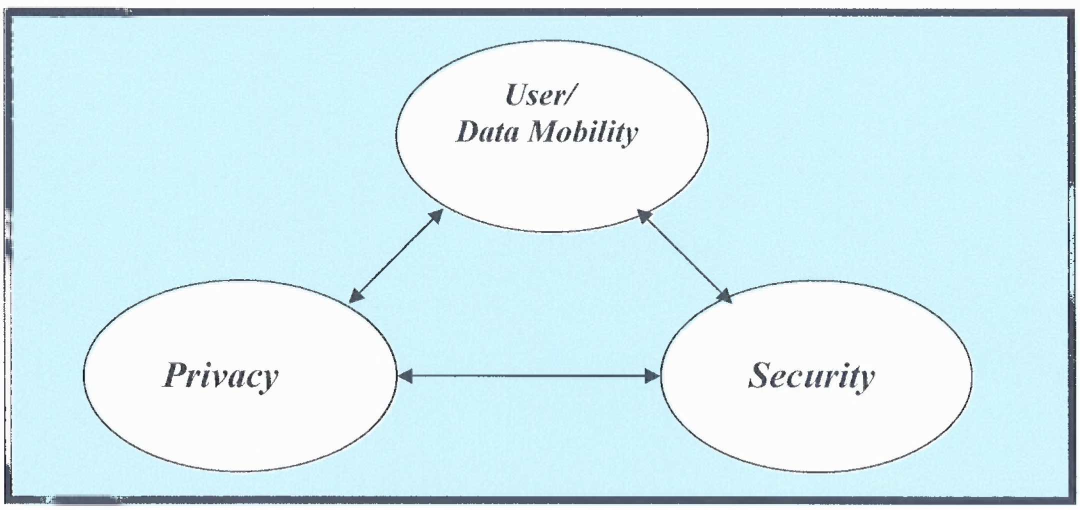


Figure 3.14 Healthcare Framework.

Parameters:

These are three major parameters that are crucial to clinical healthcare integration and information technology adoption:

- User /Data mobility – Clinicians need to be mobile in a healthcare environment as they interact with patients, i.e., moving from patient to patient and or bedside to bedside administering care.
- Privacy (Confidentiality) – Is a systems ability to control the release of information about itself.
- Security - A systems ability to protect against unauthorized entry, misuse or takeover.

The parameters stated above were discussed throughout the literature review sections of the dissertation (section 2.1 through 2.6.6 and Figure 2.12).

Data Collection:

Composite population was Information Technology professionals within the industry, healthcare information technology professionals, and clinical providers (physicians) and healthcare professionals (See section 3.3.1 - 3.4.2).

Sample Size:

Sample size was determined by the organization where the study took place. Discussion centered on several options for the research site used. There were two pre-pilot studies and one final study (Figure 3.13) and the breakdown is depicted below.

- Teaching hospital with Medical school affiliation
- Multiple hospital environment
- Multi- physician practice
- Solo physician practice
- Clinics

3.3 Pilot Study II

Listed below are research questions associated with pilot study II which was conducted in order to identify information technology tools required for conducting daily tasks.

- **RQ1:** Will there be a disparity between clinical healthcare provider tasks and information technology applications adoption?
- **RQ2:** Will increased clinical information technology usage improve patient quality of service?
- **RQ3:** Will the clinical practitioners with higher device mobility experience greater IT adoption?
- **RQ4:** Will the increased levels of clinical staffers' IT knowledge will facilitate IT staffers' integration?
- **RQ5:** will there be a different perception between IT staff and clinical healthcare staff regarding tools required for clinical healthcare delivery (service and utilization)?

Refer to the cross tabs for Study II in Appendices F.2 – F2.2 for Descriptive Statistics.

3.3.1 Measurement

Technical Gap: Computerization of IT services for clinical staff **(RQ1).**

- Forms the type and level of the service provided by IT.

Technology Gap: Technology fit between the technological task and the information technology required **(RQ2, RQ5)**.

- Documents the technology within the provider's environment and the task(s) that are being performed; i.e., does the information technology provided fit requirements of the job?
- Measures the level of IT between technology and tasks.
- Levels of security (includes confidentiality and privacy).

Adoption Gap: Effect - Clinical Information Technology Adoption Effect **(RQ3, RQ4).**

- Determine if recommended IT is a correct fit that leads to adoption of information technology in a clinical environment).

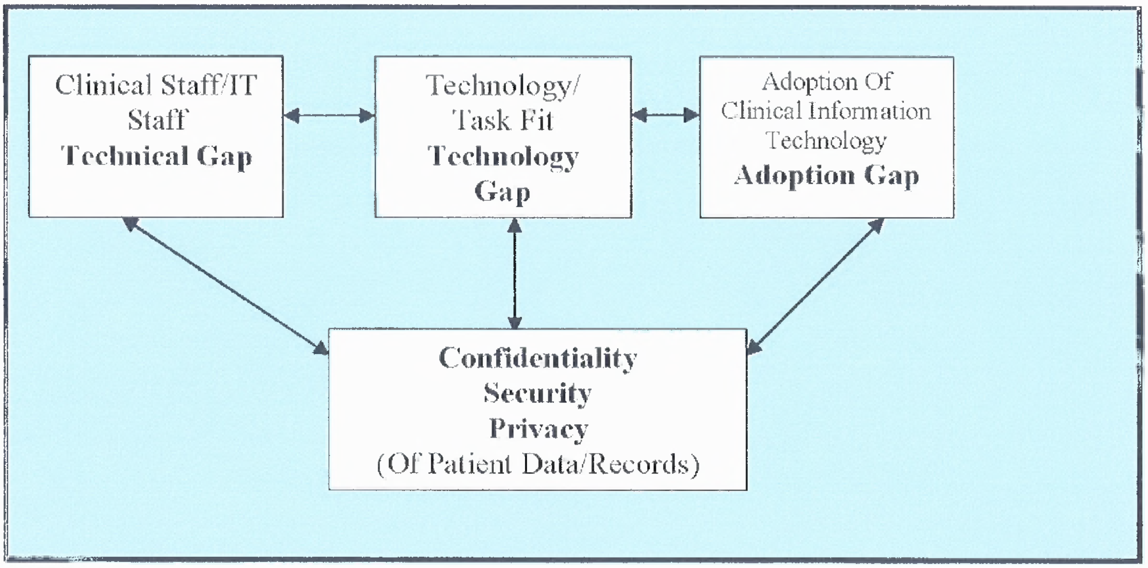


Figure 3.15 Model of the Healthcare Environment.

Research Questions and Gap Analysis Model

The technical gap between information technology staff and clinical healthcare staff (providers) has been established based on the disparity of clinical applications. The fit between the task and the technology must be established and documented. The IT adoption lag in the clinical healthcare environment will not be undertaken as part of this research; however perception differences will be explored. Adoption and diffusions studies are sparse in the healthcare environment; this part of the research has been discussed in the Literature Review section of this document which builds upon previous work conducted by researchers, some of which appear in Table 2.6.

3.3.2 Study II Research Questions with Variables and Gap Analysis

Table 3.7 Research Questions.

Computerization (RQ1)	Technology Task/Fit (RQ2/RQ5)	Adoption (RQ3/RQ4)
Services provided by IT	Appropriateness of technology	Clinical technology adoption
Information/Clinical systems	Mobility	Is the innovation being used
IT Tool (e.g., PC, PDA etc.)	Security/Privacy features	Is there resistance to the innovation
Support services	Scalability	Do provider perceive the innovation will be useful
Training/software & hardware	Dependability	Will it save time
Security/Privacy features	Reliability	Do they believe the innovation will improve productivity
	Ease of use	
	Perceived usefulness	
	Timeliness	
	Correctness	

3.4 Final Study III – 86 Participants

3.4.1 Study III

Objectives: The following analysis will focus on identifying the gap in perception between Information Technology and Clinical Healthcare professionals as it relates to information technology requirements in a clinical environment. That is what is the perception of clinicians who need to do their day to day tasks in a clinical setting; and how is that need/requirement perceived by those information technology professional that design and implement these IT initiative?

The business of healthcare is to delivery care to patients at their point of entry into the healthcare system. Physicians and other healthcare providers operation in a life and death environment where in most cases they need to be able to move the patient through the healthcare maze so that the appropriate tests and treatment plans are administered in a timely manner. Added to this dynamic is the need for maintaining a record (electronic (EHR) or paper chart) of care administered to the patient. This information is usually found on the patient health or medical record; it must be secure and ensure that the confidentially of the patient receiving treatment is protected by federal legislation (HIPPA) for privacy and security.

Method:

These analyses were performed to distinguish survey items that are perceived differently between Clinical Healthcare and Information Technology domains. The scales utilized for each question analyzed can be found in the Descriptive Statistics Appendix F.3 – F.3.2 and the questionnaire (Appendix C.4 – C.5).

Task List:

Subjects are asked to perform the following tasks as part of this study:

1. The subject is given a brief overview of the research mission verbally and told what will take place during the 30 - 60 minute interview. Subjects are encouraged to ask questions at this point.

2. A copy of the "Research Introduction Letter" is given to the subject(s) so that they can get an explicit idea about why I am conducting the study, and to know what is being asked of them as participants (Appendices A.3 –A.6).

3. Next, a copy of the "Consent to Participate in a Research Study" form is given to the subject(s) to let them know their rights as participants. Once the subjects read the consent, they are asked to sign the form which indicates that they are willing to participate in the study (Appendices B.3 – B.5). Incentive cards are also given (Appendices E.1 – E.3) for random drawing for flash (non-physician) or donation to charity (physician). Physicians receive a thank you note from (Appendix E.3).

4. The signed consent forms are collected. If there is a group of subjects, one person is asked to collect the forms and place them in a pre-paid envelope for mailing to a committee member.

5. A copy of the survey is handed to the subject(s), who are asked to spend a few minutes reviewing it. This is done to determine if there is anything that needs to be explained prior to the participants' writing their responses.

Sample: The final study (III) had four categories that were listed as domains and the various professional titles within these groups follow:

- **Clinical Healthcare Provider** – Various Medical Physicians, Medical Director, Anesthesiologist, Pediatricians, Family Practice, Neurology and Psychiatry.

- **Information Technology (IT) Professional** – Software development team responsible for Information Technology applications development, implementation and maintenance, Chief Information Officer, Systems Application Manager, Project Manager and IT Security Analyst.

- **Healthcare Information Technology** – This group is a combination of IT and clinical healthcare personnel whose primary job was to deal with various aspects of patients care and clinical application within the healthcare facility.

- **Other Clinical Healthcare Provider** – Nursing, Physician Assistant, Medical Assistant, Patient Representative or anyone delivery care other than a Physician.

3. 4.2 Study III Hypotheses:

These hypotheses were developed for the Web of System Performance (WOSP) constructs.

- **H1: Security**: There is a perception difference between different groups of healthcare providers with respect to the importance of security in electronic healthcare systems.
  - **H1a**: There is a perception difference between Physicians and IT professional with respect to the importance of security in electronic health care systems.
  - **H1b**: There is a perception difference between other healthcare providers (non-physician healthcare providers) and IT professionals with respect to the importance of security in electronic health care systems.
  - **H1c**: There is a perception difference between other healthcare providers (non-physician healthcare providers) and physicians with respect to the importance of security in electronic health care systems.
- **H2: Usability**: There is a perception difference between different groups of healthcare providers with respect to the significance of electronic healthcare systems usability.
  - **H2a**: There is a perception difference between Physicians and IT professional with respect to the significance of electronic healthcare systems usability.
  - **H2b**: There is a perception difference between other healthcare providers (non-physician healthcare providers) and IT professional with respect to the significance of electronic healthcare systems usability.
  - **H2c**: There is a perception difference between other healthcare providers (non-physician healthcare providers) and physicians with respect the significance of electronic healthcare systems usability.
- **H3: Usefulness**: There is a perception difference between different group of healthcare providers with to the significance and required functionality of electronic healthcare systems usability.
  - **H3a**: There is a perception difference between Physicians and IT professional with respect to the significance and required functionality of electronic healthcare systems usability.
  - **H3b:** There is a perception difference between other health care providers (non-physician healthcare providers) and IT professional with respect to the significance and required functionality of electronic healthcare systems usability.

- **H3c:** There is a perception difference between other healthcare providers (non-physician healthcare providers) and physicians with respect the significance and required functionality of electronic healthcare systems usability.

- **H4: IT Adoption**: There is a perception difference between different groups of healthcare providers with respect to their level of IT adoption.
  - **H4a**: There is a difference between Physicians and IT professional with respect to their level of IT adoption.
  - **H4b**: There is a perception difference between other healthcare providers (non-physician healthcare providers) and IT professional with respect to their level of IT adoption.
  - **H4c**: There is a perception difference between other healthcare providers (non-physician healthcare providers) and physicians with respect to their level of IT adoption.

- **H5**: There exists a different perception between IT staff and clinical healthcare staff regarding tools required for clinical healthcare delivery (service and utilization).

- **H6**: The higher the level of perceived importance of security for an electronic healthcare system, the higher the level of IT adoption.

- **H7**: Level of IT knowledge is positively correlated with IT adoption.
  - **H7a**: As level of healthcare professional IT knowledge increases, their level of IT adoption increases as well.
  - **H7b**: As level of healthcare professional IT usage increases, their level of IT adoption increases as well

The next chapter (4) discusses the analysis of the data collected and subsequent results of the tests that were conducted.

CHAPTER 4

RESULTS

4.1 Overview

An overview of how Study III data were collected and prepared for statistical analysis is presented here. There were a total of 86 participants in this research study. Seventy-five percent of the participants were employed throughout the State of New Jersey and participated in face-to-face sessions where they completed the questionnaire for this study. These interactions were scheduled over several months (Fall 2006 through May 2007) at the participants' work sites in one or two sessions depending on departmental availability. Each session included a briefing about the research and the discussions/signing of the consent form prior to the distribution and completion of the questionnaire (Refer to Study III methodology, Chapter 3)

The other twenty-five percent of the study population was solicited by mailing packets sent to physicians throughout several states (See Appendices A.3 – A.5, B.4, C.4 – C.5 and E.1). Completed surveys were forwarded to designated committee members to maintain participants' anonymity and the integrity of the data collected (See Appendices B.4 and E.1 – E.2). A packet was submitted to the researcher after all surveys and consents were accounted for and data analysis could begin

4.2 Study Overview

Input from several different focus groups which included: UMDNJ, Montclair Family Health Center, Trinity Pediatrics, Saint Clare's, and IT and healthcare professionals were instrumental in the construction of the final survey (Appendices C.4 – C.5). Two stakeholders responsible for information technology acquisition participated in structured interviews which were further tested with the assistance of a family practice physician (Appendices C.4 – C.5). This physician evaluated the survey to ensure the questions targeted towards clinical healthcare providers were represented and to ensure that a 15 minute time frame would be adhered to for completion. The Flesch-Kincaid Readability Test (Cooper and Schindler, 2001) was used to determine the level of reading difficulty for the survey participants (Reading Ease 38.3 and Grade Level 11.5).

Study III was updated to reflect recommendations from the dissertation committee to include questions that tested for the perceptions about IT adoption in a clinical environment with regard to the Web of System Performance (WOSP):

- Electronic Health Record Adoption
- Security (WOSP)
- Privacy (WOSP)
- Functionality (WOSP)
- PDA Use
- TAM2 (Usability and Ease of Use)

Constructs for each of these variables are included in Appendix D.3 where each question is linked to a construct. Healthcare and information technology researchers along with a physician wrote an appeal letter that accompany each mailing and was given to every participant who completed the survey (see Appendices A.3 – A.5). The Flesch-Kincaid scores (Cooper and Schindler, 2001) are as follows: Reading Ease 32.9 and Grade Level 12.7.

4.2.1 Data Collection

This type of data collection was tedious and had numerous time constraints due to the need to constantly account for consents and surveys associated with face-to-face and mail solicitation. Packets that were mailed included pre-paid return postage for the completed surveys to be sent to a committee member for reviewing. There was a May 31, 2007 cutoff for all participations in this research study.

4.2.2 Study Participants

The final study (III) had four categories that were listed as domains and the various professional titles within these groups as follows:

- **Clinical Healthcare Provider** – Medical directors, various types of physicians including anesthesiologists, pediatricians, family practice physicians, neurologists and psychiatrists.
- **Information Technology (IT) Professional** – Software development team responsible for information technology applications development, implementation and maintenance; Chief Information Officer, Systems Application Manager, Project Manager and IT Security Analyst.
- **Healthcare Information Technology** – This group is a combination of IT and clinical healthcare personnel whose primary job was to deal with various aspects of patient care and clinical applications within the specific healthcare facility.
- **Other Clinical Healthcare Provider** – Nurses, physician assistants, medical assistants, patient representatives, or anyone other than a physician who was involved in the delivery of patient care.

When WOSP Constructs are evaluated three groups are used: information technology and healthcare information technology professionals are combined to create one group for analysis purposes (refer to Appendix D.3 for WOSP Constructs). These are:

- **Group 1** – Clinical Healthcare Provider (Physician)
- **Group 2** – Information Technology Professionals (combined with Group 3 Healthcare IT)
- **Group 4** – Other Clinical Healthcare Provider (Non-Physician)

4.2.3 Data Cleaning

Through visual examination of the SPSS data file and running factor analysis, it was necessary to eliminate those surveys with large numbers of missing data. During visual inspection and descriptive analysis deploying SPSS, 16 observations had to be removed from the SPSS file. Two variables (questions) were eliminated from analysis because they had six or more missing responses from participants. The two questions are listed below with the number of missing values:

1. "If I am not using an EHR system, I believe that adding this terminology will increase productivity." This variable has 13 missing values and was labeled as Q19.
2. "The template that the computerized tool uses for patient data input makes it easy to recognize errors." This variable has 6 missing values and was labeled as Q38.

<u>**Exclusions**</u>

Of the 16 observations mentioned above ten surveys were excluded from any type of statistical data analysis due to variables (questions) that had more than four missing values.

Missing Data Issues

Finally, to address the remaining six observations that had missing values, "means substitution" was applied for data variables (questions) and suggestions from the Andy Field book (2003) was applied. That is, the average of the variable was calculated per person and inputted as the estimated value for the missing value(s) of the variable(s). This procedure was used only for surveys that had no more than two missing values, and of the 6 there was only one that fell into that category.

Variables Not Tested

The following questions were dropped from the SPSS file and not analyzed for the T-Test and Mann-Whitney U test which compared differences between domains.

1. "Cost has been a significant factor in preventing the adoption of an electronic health record (EHR) system for clinical healthcare in my organization", Q16.
2. "Clinical healthcare systems developed by an in-house information technology department are able to be integrated into existing organizational applications", Q17.
3. "Using computerized clinical healthcare systems will increase the time it takes to complete daily clinical tasks", Q21.
4. "Using a wireless network connection to transmit patient information will create privacy risks", Q25.
5. "Utilizing a PDA will decrease my productivity", Q33.
6. "The EHR system will increase our operating costs", Q34.
7. "PDA's are confusing to use", Q36.

8. "Training will be required in order to effectively use the PDA for patient data capture", Q37.
9. "If I become skillful with a computerized tool, this will cut down on the time it used to take to complete a task manually", Q39.

The general flow of how the data was processed is as follows:

A. Cross Tabulations indicate adoption statistics for electronic health records in the clinical environment and the implications of the study.
B. Data analysis follows starting with T-Tests that compare perception differences in participants and explore physicians' attitudes and perceptions regarding the existing systems analysis and design of clinical IT requirements. The statistical significance in the T-Test was mostly consistent with Mann-Whitney U Tests. However, the Mann-Whitney U Tests revealed a few more differences.
C. The second set of statistical results are WOSP constructs which determine significance for clinical IT and the WOSP model, Mann-Whitney U Tests were used (refer to WOSP Constructs - Appendix D.3).

Based on the study results in part B, it was realized that participant group numbers 2 (IT professionals) and 3 (healthcare information technology professionals) statistically represent the same population. That is, there were no statistical significant differences between those two groups among all questionnaire items. Therefore, to increase statistical sensitivity for the two groups involved in this statistical analysis, the researcher combined the two groups into one. All the related WOSP constructs for clinical IT (security, usability, usefulness and IT adoption) are studied by combining groups 2 and 3.

4.3 Perception Differences (Results)

4.3.1 Comparison between Healthcare Providers (Physicians) and Information Technology Professionals

It should be noted that **p <0.05 or less is considered significant in the tables that follow, other p-values are simply included.

Healthcare providers' (physicians) perceptions in reference to electronic health records systems were rated significantly higher than those for information technology on the following items (not shaded). For the shaded items IT professionals' perceptions were rated higher than healthcare providers (physicians) on those questions in the table (4.8).

Table 4.8 Health Care Provider (Physicians) vs. Information Technology.

Question	t - value	p - value
14b. EHR systems with an audit trail will have to have the highest security.	2.276	.037**
14c. EHR systems with an audit trail will have to have ease of use.	1.878	.079*
14e. EHR systems with an audit trail will have to have usefulness.	2.521	.027**
14f. EHR systems with an audit trail will have to have compatibility.	1.833	.076*
14g. EHR systems with an audit trail will have to have reliability	2.368	.024**
24. A computerized clinical healthcare system will produce useful patient data.	-1.755	.088*
35. The quality of patient care will increase with the use of computerized tools.	-2.449	.020**
40. I believe a PDA is adequate for the display of complex patient data.	1.753	.089*

* p < 0.1; ** p < 0.05; ***p <0.01; ****p <0.001

Results:

- In all categories on Table 4.8 there is a statistically significant difference between physicians' and healthcare information technology professionals' point of view of essential required functionalities for an EHR system. However this difference is particularly evident for "ease of use", "usefulness", "and system reliability", "production of useful data", "quality of patient care." The difference is less significant for information technology professionals (grey shaded area).
- With respect to requiring an audit trail (14a -14g) for Electronic Health Records (EHR) physicians on average rated these factors higher than healthcare information technology professionals.
- In 'question 14', participants are asked the important of audit trails in an EHR system. The difference that is reflected in this response rates healthcare providers (physicians) higher than information technology professionals. EHR systems with audit trails emphasize a way to follow the test results and treatment plan for the patient in their care. Healthcare providers perceive this level of security necessary for patient care and confidentiality of their health status. Relating back to the WOSP model and performance constructs, healthcare providers have unique requirements that entail systems that ensure security, privacy and reliability for patient data. Referring to Figures 2.10, WOSP model these constructs are on the left-most side of the WOSP model; that is what healthcare providers (physicians) perceive as important for clinical IT performance. IT professionals perceive the right most side of the WOSP model as the constructs that are important for IT applications (Figure 2.9).

- PDA display of complex data was considered adequate for physician usage. The perception of what is required by physicians to determine critical and complex data is different than the perception of IT professionals.
- Information technology professionals perceived that more useful patient data was produced with computerized clinical healthcare systems. The perception of what healthcare providers (physicians) thought was not rated as significant as what IT professionals thought (grey shaded area).
- Information technology professionals perceived that the quality of patient care would increase with computerized tools. The perception of what healthcare providers (physicians) thought was not rated as significant as what IT professionals thought (grey shaded area).
- Referring to Figure 2.9 (WOSP model), these constructs are on the right-most side of the WOSP model and that is what information technology professionals perceive as important for IT performance.

4.3.2 Comparison between Healthcare Providers (Physicians) and Healthcare Information Technology

Table 4.9 Healthcare Provider (Physicians) and Healthcare Information Technology.

Question	t - value	p - value
14a. EHR systems with an audit trail will have to have the highest security.	-1.817	.083*
14e. EHR systems with an audit trail will have to have usefulness.	2.092	.043**
14f. EHR systems with an audit trail will have to have compatibility.	2.681	.011***
23. Security is a major factor in determining information technology requirements for EHR.	-2.039	.049**
24. A computerized clinical healthcare system will produce useful patient data.	-2.324	.026**
26. There is a need for computerization of patient records (EHR).	-2.265	.032**
40. I believe a PDA is adequate for the display of complex patient data.	2.303	.027**

*** $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$; ****$p < 0.001$**

Results:

- A significant difference was found between healthcare information technology professionals and physicians in regard to the rating of highest security as important for EHR systems. Healthcare information technology professionals were more likely to rate highest security as necessary for EHR systems as were healthcare physicians.

- With respect to requiring an audit trail (14e -14f) for Electronic Health Records (EHR), physicians on average rated these factors higher than did healthcare information technology professionals.
- PDA display was considered adequate for physician usage but was rated significantly higher than for healthcare information technology professionals.
- Healthcare information technology professionals had a significant difference regarding security as an important factor in EHR requirements. Physicians did not rate this as high which can be attributed to healthcare IT professionals understanding the security risk associated with electronic patient records (grey shaded area).
- Healthcare information technology professionals' perception that more useful patient data was produced with computerized clinical healthcare systems was significant. Healthcare providers' (physicians') perceptions were not rated as significant as those of healthcare IT professionals (grey shaded area).
- Healthcare information technology professionals had a significant difference regarding the computerization of patient health records. Physicians did not perceive this as high which can be attributed to healthcare IT professionals understanding the security and legislative requirements associated with electronic patient records adoption (grey shaded area).

4.3.3 Comparison between Healthcare Providers (Physicians) and Other Healthcare Providers

Table 4. 10 Healthcare Providers (Physicians) and Other Healthcare Providers.

Question	t - value	p - value
14a. EHR systems with an audit trail will have to have the highest security.	2.256	.030**
14b. EHR systems with an audit trail will have to have friendliness.	2.781	.008***
14c. EHR systems with an audit trail will have to have ease of use.	2.508	.016**
14e. EHR systems with an audit trail will have to have usefulness.	4.101	.000***
14f. EHR systems with an audit trail will have to have compatibility.	3.131	.003***
14g. EHR systems with an audit trail will have to have reliability.	3.552	.001***
29. A personal digital assistant (PDA) will let me complete EHR tasks more efficiently.	-1.917	.061*
40. I believe a PDA is adequate for the display of complex patient data.	-1.842	.074*

* $p < 0.1$; ** $p < 0.05$; ***$p < 0.01$; ****$p < 0.001$

Results:

- A significant difference was found between physicians and other healthcare providers in regard to the rating of highest security as important for EHR systems. Physicians were more likely to rate highest security as necessary for EHR systems than other healthcare providers. This perception could be associated with solo and group physician practices which have started the conversion to an electronic system understanding the need to move away from paper records.

- In all categories in Table 4.10 there is a statistically significant difference between physicians' and other healthcare providers' points of view of essential required functionalities for an EHR system. However this difference is particularly evident for "security" "ease of use", "usefulness", "and system reliability". The difference is less significant for other healthcare providers.
- In Question 14 participants are asked the importance of audit trails in an EHR system. The difference reflected in this response rates healthcare providers (physicians) higher than other healthcare providers. EHR systems with audit trails emphasize a way to follow test results and treatment plans for the patients in their care. Healthcare providers perceive this level of security necessary for patient care and confidentiality of their health status. Relating back to the WOSP model and performance constructs, healthcare providers have unique requirements that entail systems that ensure security, privacy and reliability for patient data. Referring to Figure 2.10 (WOSP model), these constructs are on the left-most side of the WOSP model; that is what healthcare providers (physicians) perceive as important for clinical IT performance.
- Other healthcare providers perceived the PDA as a tool that would allow them the ability to complete EHR tasks efficiently. Physicians perceived this as less significant (grey shaded area).
- PDA display was considered adequate for other healthcare provider usage and was rated higher than that of physicians (grey shaded area).

4.3.4 Comparison between Information Technology and Healthcare Information Technology

Table 4. 11 Information Technology vs. Healthcare Information Technology.

Question	t - value	p - value
14a. EHR systems with an audit trail will have to have the highest security.	-1.760	.104*

* p < 0.1; ** p < 0.05; ***p <0.01; ****p <0.001

Results:

- A significant difference was found between healthcare information technology professionals and information technology professionals in regard to the rating of highest security as important for EHR systems. Healthcare information technology professionals were more likely to rate highest security as necessary for EHR systems as information technology professionals work in both domains (grey shaded area).

4.3.5 Comparison between Information Technology vs. Other Healthcare Providers

Table 4. 12 Information Technology and Other Healthcare Providers.

Question	t - value	p – value
30. PDA's will have an interface that is easy to use.	-2.795	.008***
31Training in the usage of PDA's will not be required; I will be able to use the tool immediately.	-1.982	.054*
32. Productivity will be increased with the use of a PDA for my day to day responsibilities.	-2.240	.020**
40. I believe a PDA is adequate for the display of complex patient data.	-4.333	.000****

*p < 0.1; **p < 0.05; ***p <0.01; ****p <0.001

Results:

- PDA display was considered adequate for the display of patient data and the perceived difference was rated higher by other healthcare providers. Information technology professionals did not perceive this the same way (grey shaded area).
- Other healthcare providers perceived training in the usage of PDA's or training as a requirement to being able to use the tool. The perceived difference was rated higher than for information technology professionals (grey shaded area).
- Other healthcare providers perceived a significant increase in productivity with the use of a PDA for daily responsibilities. The perceived difference was rated statistically higher than for information technology professionals (grey shaded area).
- PDA display was considered adequate for other healthcare provider usage and was rated higher than for information technology professionals (grey shaded area).

4.3.6 Comparison between Healthcare Information Technology and Other Healthcare Providers

Table 4.13 Healthcare Information Technology and Other Healthcare Providers.

Question	t - value	p - value
14a. EHR systems with an audit trail will have to have the highest security.	2.923	.006***
14e. EHR systems with an audit trail will have to have usefulness.	2.800	.008***
14g. EHR systems with an audit trail will have to have reliability.	3.055	.004***
24. A computerized clinical healthcare system will produce useful patient data.	2.194	.033**
26. There is a need for computerization of patient records (EHR).	2.976	.005***
29. A personal digital assistant (PDA) will let me complete EHR tasks more efficiently.	-2.192	.033**
30. PDA's will have an interface that is easy to use.	-3.362	.002***
31Training in the usage of PDA's will not be required; I will be able to use the tool immediately.	-3.156	.003***
32. Productivity will be increased with the use of a PDA for my day to day responsibilities.	-1.648	.106*
34. The EHR system will decrease our operating costs.	-1.702	.095*
40. I believe a PDA is adequate for the display of complex patient data.	-5.296	.000****

*$p < 0.1$; ** $p < 0.05$; ***$p < 0.01$; ****$p < 0.001$

Results:

- With respect to requiring an audit trail (14a, 14e and 14g) for electronic health records (EHR), healthcare information technology, on average, ranked these factors statistically higher than did other healthcare providers.
- A significant difference was found between healthcare information technology professionals and other healthcare providers in regard to the rating of highest security as important for EHR systems. Healthcare information technology professionals were more likely to rate highest security as necessary for EHR systems as healthcare information technology professionals work in both domains.
- Healthcare information technology professionals had a significant difference regarding security as an important factor in EHR requirements. Other healthcare providers did not rate this as high which can be attributed to healthcare IT professionals understanding the security risk associated with electronic patient records.
- Healthcare information technology professionals' perception that more useful patient data was produced with computerized clinical healthcare systems was significant. Other healthcare providers' perceptions were not rated as significant as those of healthcare IT professionals.
- Other healthcare providers perceived the PDA as a tool that would allow them the ability to complete EHR tasks efficiently. Healthcare information technology professionals perceived this as less significant (grey shaded area).

- PDA display was considered adequate for the display of patient data and the perceived difference was rated higher by other healthcare providers. Healthcare information technology professionals did not perceive this the same way (grey shaded area).
- Other healthcare providers perceived training in the use of PDA's as a requirement to being able to use the tool. The perceived difference was rated higher than that of healthcare information technology professionals (grey shaded area).
- Other healthcare providers perceived a significant increase in productivity with the use of a PDA for daily responsibilities. The perceived difference was rated statistically higher than that of healthcare information technology professionals (grey shaded area).
- Other healthcare providers perceived a significant decrease in operating costs with the introduction of an EHR; whereas healthcare information technology professionals rated this significantly lower (grey shaded area).
- PDA display was considered adequate for other healthcare provider usage and rated higher than did healthcare information technology professionals (grey shaded area).

4.4 WOSP Constructs

These WOSP constructs (see Figure 3.11 and Appendix 4.C) that have been tested using the Mann-Whitney U Test in SPSS for statistical significance results follow in Tables 4.14 – 4.16.

For data analysis purposes information technology and healthcare information technology groups have been combined into one group. The three groups used in the WOSP construct analysis are as follows:

- Group 1 – Physicians
- Group2 - IT and Healthcare IT
- Group4 - Other Healthcare providers

4.4.1 Mann-Whitney test of the WOSP Constructs

The following Mann-Whitney U Tests are listed below to indicate statistically significant results for differences in perception for the WOSP constructs of IT adoption, usefulness, security and usability. Refer to Tables 4.14 through 4.17 to see the significance between groups. As indicated in the previous section (4.2.3) the group for IT professionals has been combined into one group for testing the WOSP constructs (section 4.4).

Table 4. 14 Physicians and IT Professionals.

	IT Adoption	**Usefulness**	**Security**	**Usability**
Mann-Whitney U	337.000	293.000	276.000	244.500
Asymp. Sig. (2-tailed)	.733	.264	.151	.042**

Table 4. 15 Physicians and Other Healthcare Providers.

	IT Adoption	Usefulness	Security	Usability
Mann-Whitney U	288.000	305.500	335.500	199.000
Asymp. Sig. (2-tailed)	.230	.371	.571	.003***

Table 4. 16 IT Professionals and other healthcare professionals.

	IT Adoption	Usefulness	Security	Usability
Mann-Whitney U	274.000	470.500	451.000	401.500
Asymp. Sig. (2-tailed)	.004***	.888	.522	.185

Security Construct:

- There is no statistically significant difference in perception of importance and need of security for an Electronic Health Record system among physicians and information technology professionals
- There is no statistically significant difference in perception of importance and need of security for an Electronic Health Record system among physicians and other clinical healthcare professionals.
- There is no statistically significant difference in perception of importance and need of security for an Electronic Health Record system among IT professionals and other clinical healthcare professionals.

Summary: In general, there is no statistically significant difference in perception of importance and need of security for an Electronic Health Record system among physicians, information technology professionals and other clinical healthcare professionals.

- Other healthcare provider groups have the highest variation and IT professionals have the least variation.
- Physicians have the highest STD, with the lowest average, presenting more diversity in terms of perceived importance and type of required functionality

Usefulness and Functionality:

- There is no statistically significant difference in perception of significance and type of required functionalities and capability for an Electronic Health Record system among physicians and information technology professionals.
- There is no statistically significant difference in perception of significance and type of required functionalities and capability for an Electronic Health Record system among physicians other clinical healthcare professionals.
- There is no statistically significant difference in perception of significance and type of required functionalities and capability for an Electronic Health Record system among IT professionals and other clinical healthcare providers.

Summary: In general, there is no statistically significant difference in perception of significance and type of required functionalities and capability for an Electronic Health Record system among physicians, information technology professionals and other clinical healthcare providers.

Usability:

- There is a statistically significant difference in perception of significance and usability of an Electronic Health Record system among physicians and information technology professionals.

- There is a statistically significant difference in perception of significance and usability of an Electronic Health Record system among amongst Physicians and other clinical healthcare providers.
- There is no statistically significant difference in perception of significance and usability of an Electronic Health Record system among IT professionals and other clinical healthcare providers.

Summary: In general, there is a statistically significant difference in perception of significance and usability for an Electronic Health Record between physicians and IT professionals, as well as between physicians and other clinical healthcare providers.

The standard deviation (STD) of this construct is larger than the other four constructs, with Physicians having the largest Standard Deviation which is over 1.00.

The average of IT professionals is the highest presenting the most perceived (6.0) belief in the functionality of Electronic Health Record systems.

IT Adoption:

- There is no statistically significant difference among physicians and information technology professionals with regards to their perceived level of technology adoption.
- There is no statistically significant difference among Physicians and other healthcare providers with regards to their perceived level of technology adoption.
- There is a statistically significant difference among Information Technology professionals and other clinical healthcare providers with regard to their perceived level of technology adoption.

- The other health care providers have the highest average towards IT adoption, with the second largest standard deviations (STD). The physicians group has the highest STD, as expected based on the statistical findings in this study.

Point of Contrast:

One Way ANOVA test confirms the findings of the non-parametric Mann-Whitney test. The ANOVA one way test showed that there are slight differences in perceived IT adoption among the three groups and significant statistical differences among all three groups in terms of their perceived usability expectations. This test also revealed that there are no statistically significant differences among the three groups in terms of perceived importance and required usability and security.

Table 4.17 Significant WOSP Constructs.

	Usability	Usefulness/Functionality	Security	IT-Adoption
Physician & IT Professionals	X			
Physician & other Healthcare providers	X			X
IT & other Healthcare providers				

Table 4.17 represents statistically significant differences among groups. The boxes marked with an 'X' indicate which construct showed significance.

<u>**Group characteristics of the WOSP constructs:**</u>

Group 1 - Physicians: This group has the highest standard deviation (STD) for IT adoption and IT perceived usability, as this group comprises a wide spectrum of physicians with IT exposure (informal or formal training) and IT application (how to apply information technology). Physicians participating in this study also varied in years of experience, age and usage of clinical applications.

Group2 - IT and Healthcare IT Professionals: This group consistently has the lowest standard deviation (STD) for all the constructs, representing more common perceived preferences toward security, usability, usefulness and IT adoption.

Group4 - Other Healthcare Providers: This group consists of nurses, office managers. and medical technicians. Therefore, this sample population has a good mix and cross section of educational level, skill sets and perceptions within the group.

Table 4.18 WOSP Construct Statistics

			N	Mean	Std. Deviation
Security	1 Clinical Healthcare Provider (Physician)		23	6.3391	.72221
	2 Information Technology Professional		31	6.5806	.49357
	4 Other Clinical Healthcare Provider		32	6.3750	.81081
	Total		86	6.4395	.68724
	Model	Fixed Effects			.68691
		Random Effects			
IT Adoption	1 Clinical Healthcare Provider (Physician)		23	5.2572	1.07159
	2 Information Technology Professional		31	5.2124	.46490
	4 Other Clinical Healthcare Provider		31	5.6237	.81447
	Total		85	5.3745	.80699
	Model	Fixed Effects			.79363
		Random Effects			
Usefulness	1 Clinical Healthcare Provider (Physician)		23	5.6377	1.00836
	2 Information Technology Professional		31	5.9892	.64540
	4 Other Clinical Healthcare Provider		31	5.8978	.87842
	Total		85	5.8608	.84314
	Model	Fixed Effects			.84113
		Random Effects			
Usability	1 Clinical Healthcare Provider (Physician)		23	6.4855	.23524
	2 Information Technology Professional		31	6.2258	.44420
	4 Other Clinical Healthcare Provider		32	5.8281	.95741
	Total		86	6.1473	.69987
	Model	Fixed Effects			.65448
		Random Effects			

4.4.2 Building WOSP Constructs

To build the WOSP constructs for usability, usefulness and security, one must not only consider the theoretical definition of these constructs but also the general view and perception of respondents in addressing and answering questionnaire items (Appendix D.3). After data collection, items pertaining to theoretical and perceptive underlining of constructs were selected. The appropriateness of such a choice of questionnaire items per construct was confirmed through reliability and factor analysis deploying Principle Component Analysis (see Tables 4.19 through 4.22).

Reliability Test:

- A reliability test determines Scale's internal consistency. A reliability test reveals the degree that items which build a factor "hang together" or how their collection coherently builds a construct. A high Cronbach's alpha >= .70 represents that all constituents items are measuring the same associated construct.

Factor Analysis:

- Factor analysis is a data reduction technique used to reduce the numbers of variables to a smaller set of factors. It adds to the information provided by reliability test on how data hangs together. "Factor loading" is a measure of substantive importance of a particular variable to a factor" (Field, 2000). Factors are thought to reflect underling processes that have created the correlations among variables". All items with factor loading less than 0 .5 should be extracted from the construct.

4.4.3 Cronbach's Alpha for WOSP Constructs

Table 4.19 Security Construct.

Questionnaire Item	Loading Factor
q23: Security is a major factor in determining IT requirements for EHR:	**.917**
q27: Maintaining a secure environment for patient records is very important:	**806**
q22: Confidentiality is a major factor in determining IT requirements for EHR:	**.709**
q14a: EHR system with an audit trail will have to have the highest security: .855 (second component)	**.855**
q14d: EHR system with an audit trail will have to have private access:.820 (second component)	**.820**

Reliability Statistics: Cronbach's Alpha: .760

Table 4.20 Usability Construct.

Questionnaire Item	Loading Factor
q14b: EHR system with an audit trail will have to have friendliness:	**. 863**
q14c: EHR system with an audit trail will have to have ease of use:	**. 786**
q14e: EHR system with an audit trail will have to have usefulness:	**. 781**
q14f: EHR system with an audit trail will have to have compatibility:	**. 772**
q14g: EHR system with an audit trail will have to have reliability:	**. 764**
q8: In clinical healthcare, how important is it to have immediate access to information?:	**. 732**

Reliability Statistics: Cronbach's Alpha: .760

Table 4.21 Usefulness/Functionality Construct.

Questionnaire Item	Loading Factor
q35: The quality of patient care will increase with the use of computerized tools	.738
Q18: New applications have the ability to be modified and or upgraded	.713
Q26: There is a need for computerization of patient health records	.709
Q20: Time it takes to complete daily tasks will decrease with EHR	.686
q24: A computerized clinical healthcare system will produce useful patient data	.660
Q28: Maintaining computerized patient EHRs decreases medical errors	.495

Reliability Statistics: Cronbach's Alpha: .729

Table 4.22 IT Adoption Construct.

Questionnaire Item	Loading Factor
Q30: PDA's will have an interface that is easy to use:	.771
Q29: A PDA will let me complete EHR tasks more efficiently:	.760
Q32: Productivity will be increased with the use of a PDA:	.709
Q31: Training in the usage of PDAs will not be required:	.580
Q20: Time it takes to complete daily tasks will decrease with EHR:	.520
q26: There is a need for computerization of patient health records: (second component)	.803
q24: A computerized clinical healthcare system will produce useful patient data second component)	.775
q18: New applications have the ability to be modified and or upgraded (second component)	.560
q28: Maintaining computerized patient EHRs decreases medical errors (third component)	.866
q35: The quality of patient care will increase with the use of computerized tools (third component)	.649

Reliability Statistics: Cronbach's Alpha: .805

To further understand the nature of WOSP contracts the correlation of these constructs were evaluated using Pearson Correlation (parametric method) as well as Spearman's rho (non parametric method). The result of these two studies was consistent. Both study showed significant correlation among security, usefulness and IT adoption at the population level (Table 4.23) and individual group levels (Table 4.24).

Table 4.23 Correlations between WOSP Constructs.

		IT Adoption	Usefulness	Security	Usability
IT Adoption	Pearson Correlation	1	**.845(**)**	**.354(**)**	.062
	Sig. (1-tailed)	.	.000	.000	.287
	N	85	85	85	85
Usefulness	Pearson Correlation	**.845(**)**	1	**.515(**)**	**.185(*)**
	Sig. (1-tailed)	.000	.	.000	.045
	N	85	85	85	85
Security	Pearson Correlation	**.354(**)**	**.515(**)**	1	**.604(**)**
	Sig. (1-tailed)	.000	.000	.	.000
	N	85	85	86	86
Usability	Pearson Correlation	.062	**.185(*)**	**.604(**)**	1
	Sig. (1-tailed)	.287	.045	.000	
	N	85	85	86	86

** Correlation is significant at the 0.01 level (1-tailed); *Correlation is significant at the 0.05 level (1-tailed)

IT adoption has a high correlation with usefulness and security, while usefulness has significant correlation with all IT adoption as well as security and usability. Security is highly correlated with all the constructs and usability only with usefulness and security. The level of correlation drops significantly at the individual group levels (Table 4.24). Interestingly there is no interesting correlation among WOSP constructs, IT professionals and other healthcare providers groups are correlated for IT adoption, usefulness and security.

Table 4.24 Correlations - Individual Group Level

Table A.2 Correlations

Domain- Groups 2&3 Combined				IT Adoption	Usefulness	Security	Usability
1 Clinical Healthcare Provider (Physician)	Spearman's rho	IT Adoption	Correlation Coefficient	1.000	.895(**)	.099	.211
			Sig. (1-tailed)	.	.000	.326	.167
			N	23	23	23	23
		Usefulness	Correlation Coefficient	.895(**)	1.000	.262	.238
			Sig. (1-tailed)	.000	.	.113	.137
			N	23	23	23	23
		Security	Correlation Coefficient	.099	.262	1.000	.398(*)
			Sig. (1-tailed)	.326	.113	.	.030
			N	23	23	23	23
		Usability	Correlation Coefficient	.211	.238	.398(*)	1.000
			Sig. (1-tailed)	.167	.137	.030	.
			N	23	23	23	23
2 Information Technology Professional	Spearman's rho	IT Adoption	Correlation Coefficient	1.000	.726(**)	.580(**)	-.090
			Sig. (1-tailed)	.	.000	.000	.315
			N	31	31	31	31
		Usefulness	Correlation Coefficient	.726(**)	1.000	.592(**)	-.077
			Sig. (1-tailed)	.000	.	.000	.340
			N	31	31	31	31
		Security	Correlation Coefficient	.580(**)	.592(**)	1.000	.233
			Sig. (1-tailed)	.000	.000	.	.104
			N	31	31	31	31
		Usability	Correlation Coefficient	-.090	-.077	.233	1.000
			Sig. (1-tailed)	.315	.340	.104	.
			N	31	31	31	31
4 Other Clinical Healthcare Provider	Spearman's rho	IT Adoption	Correlation Coefficient	1.000	.849(**)	.421(**)	.317(*)
			Sig. (1-tailed)	.	.000	.009	.041
			N	31	31	31	31
		Usefulness	Correlation Coefficient	.849(**)	1.000	.571(**)	.533(**)
			Sig. (1-tailed)	.000	.	.000	.001
			N	31	31	31	31
		Security	Correlation Coefficient	.421(**)	.571(**)	1.000	.833(**)
			Sig. (1-tailed)	.009	.000	.	.000
			N	31	31	32	32
		Usability	Correlation Coefficient	.317(*)	.533(**)	.833(**)	1.000
			Sig. (1-tailed)	.041	.001	.000	.
			N	31	31	32	32

Table 4.24 on the preceding page shows correlations for the following groups:

- Group 1 – Clinical Healthcare Provider (Physician)
- Group 2 – Information Technology Professionals (combined with Group 3 Healthcare IT)
- Group 4 – Other Clinical Healthcare Provider (Non-Physician)

Note: **Correlation is significant at the 0.01 level (1-tailed); *Correlation is significant at the 0.05 level (1-tailed).

4.4.4 Regression Analysis for WOSP Constructs

Regression Analysis:

H6: The higher the level of perceived importance of security for an electronic health care system, the higher the level of IT adoption.

Predictors: Security

Dependent Variable: Adoption

To test this hypothesis multiple regressions was applied to look at the linear relationship of the input and output variables at the population level. Table 4.25 shows that that almost 12 % of variance in output variable IT adoption is explained by the level of **Perceived** importance of security.

Also the correlation study applying Pearson Correlation or R value reveals that the correlation between these two variables is relatively significant (.34)

The Significance value of .001 and the value of Standardized Beta standardized coefficient r (.345) suggests that H6 is supported. Standardized Beta coefficient is a measure of strength of association. It shows the direction and magnitude of change in a dependent variable (in standard deviation units) when an independent variable increases by one standard deviation unit (Mohtashami, 2006).

Table 4.25 Regression Analysis - Perceived Importance of Security.

Model	R	R^2
1	.354(a)	.125

Table 4.26 Multiple Regression – Security.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.377	.873		2.724	.008
	Security	.463	.134	.354	3.449	.001

Coefficients (a)

Note: Multiple regression was used to investigate possible relationship between usability (R2 = .004, sig=0.57) and IT adoptions. It failed to display any relationships.

H7a: As level of healthcare professional IT knowledge increases, their level of IT adoption increases as well.

Predictors: Q1: How often do you use a computer information system when completing daily tasks?

Dependent Variable: IT Adoption

To test this hypothesis multiple regression was used to look at the linear relationship of the input and output variables at the whole population level.

This hypothesis was rejected. Table 4.27 shows almost non-existing R2. This implies that 0% of variance in output variable IT adoption is explained by the level of IT knowledge.

Also the correlation study applying Pearson Correlation or R value reveals that the correlation between these two variables is very small. The Significance value is close to 1 (.949) and the very small value of Standardized Beta coefficient reveals that **H7a** can not be supported (Table 4.28).

Table 4.27 Pearson Correlation IT – Adoption.

Model	R	R^2
1	.007(a)	.000

Table 4.28 Pearson Correlation - IT Adoption (Q1).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.348	.420		12.749	.000
	Q1. How often do you use a computer information system when completing daily tasks?	.004	.067	.007	.064	.949

Coefficients (a)

H7b: As level of healthcare professional IT usage increases, their level of IT adoption increases as well.

Predictors: Q9a_d: How knowledgeable do you consider yourself to be about IT?

Dependent Variable: IT Adoption

To test this hypothesis multiple regressions was applied to study the linear relationship of the input and output variables at the population level.

This hypothesis was rejected. Table 4.29 shows almost non-existing R2. This implies that 0% of variance in output variable IT adoption is explained by the level of IT knowledge.

Also the correlation study applying Pearson Correlation or R reveals that the correlation between these two variables is very small. The Significance value close to 1 (.981) and the very small value of Standardized Beta coefficient reveals that **H7b** can not be supported (Table 4.30).

Table 4.29 Pearson Correlation IT – Adoption.

Model	R	R^2
1	.003(a)	.000

Table 4.30 Pearson Correlation - IT Adoption (Q9).

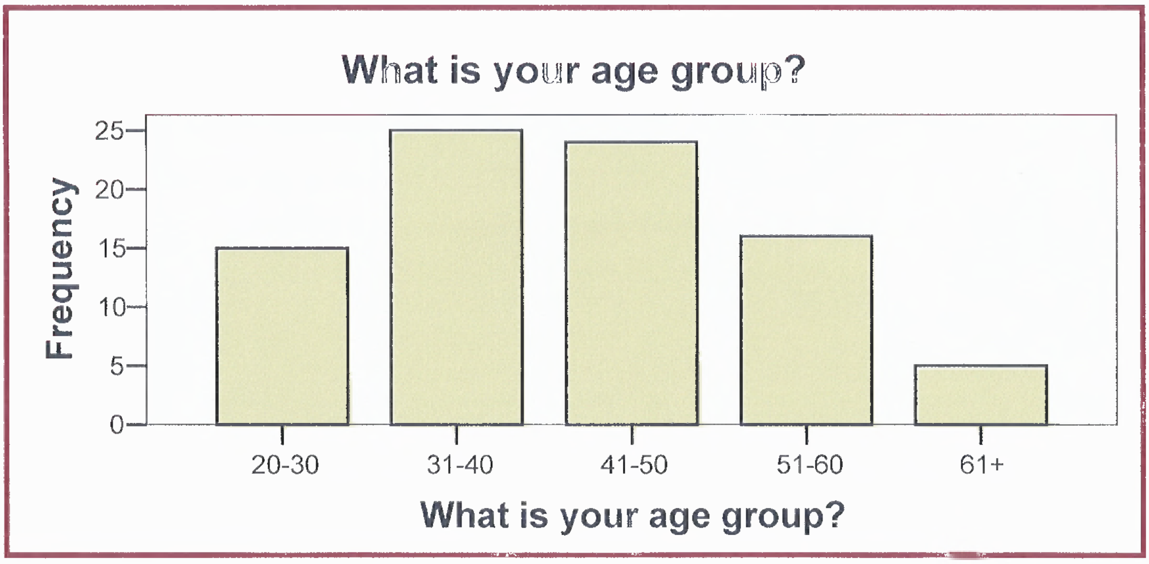
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.362	.311		17.225	.000
	Q9. How knowledgeable do you consider yourself to be about IT?	-.002	.102	-.003	-.024	.981

Coefficients (a)

Accordingly the relationship between level of education (R2 = .005, sig=0.502) and level of IT adoption is studied and no significant level of contribution of independent variable was detected.

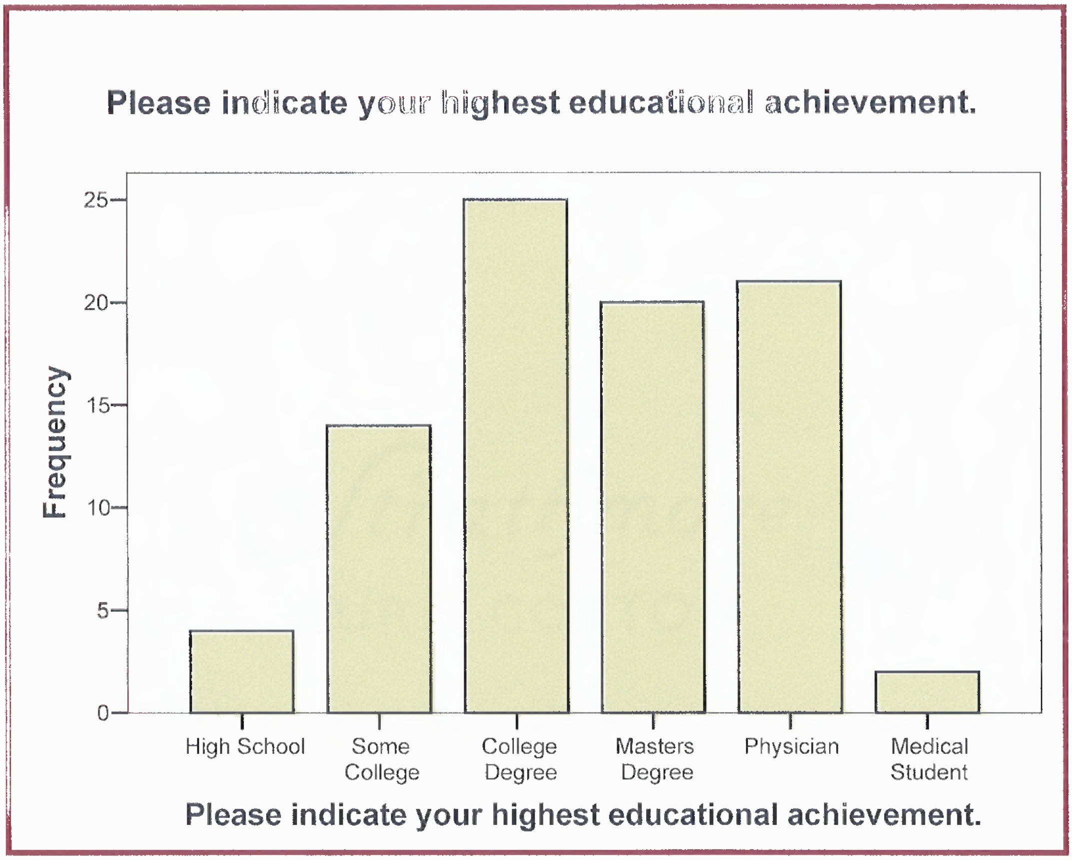
This finding was puzzling at the beginning, but after careful review of the characteristics of the respondents it made a great deal of sense. Considering that 95% of the respondents population are under 60, educated with at least a bachelor's degree and currently employed, implies that they have, and are currently using IT, somehow and somewhere in their life. It implies that through their education, work and life experience they have had considerable exposure to one or more information systems.

Therefore, they understand the importance and required functionality of IT in general and for health care systems in particular. The respondents' population to this survey is not a representative of general population. For a better understanding of the respondents attributes please refer to the age group and education charts and tables that follow:



What is your age group?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30	15	17.4	17.6	17.6
	31-40	25	29.1	29.4	47.1
	41-50	24	27.9	28.2	75.3
	51-60	16	18.6	18.8	94.1
	61+	5	5.8	5.9	100.0
	Total	85	98.8	100.0	
Missing	System	1	1.2		
Total		86	100.0		



		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High School	4	4.7	4.7	4.7
	Some College	14	16.3	16.3	20.9
	College Degree	25	29.1	29.1	50.0
	Masters Degree	20	23.3	23.3	73.3
	Physician	21	24.4	24.4	97.7
	Medical Student	2	2.3	2.3	100.0
	Total	86	100.0	100.0	

4.5 Summary Results

In summary, the researcher conducted an exhaustive literature review to ascertain a knowledge-base regarding the development of IT for clinical purposes. The result of the review of diverse literature unveiled the scarcity of theoretical and practical information regarding IT development, deployment, delivery and diffusion in health care.

Since the beginning stages of this research topic, the investigator has witnessed a slow change in attitudes and perceptions toward IT adoption among healthcare professionals. Specific issues of medication errors, paper-based health records, and security and privacy concerns are now being considered major obstacles for physicians as well as non-physicians. The random sample of respondents in the following studies were conscious of these issues and sought proactive solutions for the delivery of patient care in respective their organizations. Following are the three research studies conducted:

1. **Pilot Study I** – What is the diffusion of information technology in clinical healthcare organizations?
2. **Pilot Study II** - What information technology tools are required by clinical healthcare providers as they conduct their daily tasks and deliver quality patient care?
3. **Final Study III** - What is the perception of information technology professionals and clinical healthcare providers regarding IT requirements for delivery of patient care?

Results from pilot study I revealed that there were barriers to IT adoption for systems that were currently in place.

a. Functionality
b. User-Friendliness/Integration
c. Faster Response Time

The daily tasks of frontline healthcare providers (i.e. nurses) are sometimes made more difficult because IT managers often lack detailed professional knowledge about their users, and the context in which IT is utilized (Sallas, Mathews, Watkins and Wiley-Patton, 2007). To satisfy healthcare initiatives the need for cross-training is essential.

Clinical healthcare and medical informatics systems must be designed to include the constructs that keep threats from penetrating the IT environment. The Web of System Performance (WOSP) shows potential for providing a collaborative model for clinical healthcare and information technology (see Figures 2. 9 - 2.12). Whitworth and Zaic (2003) state "the WOSP model provides a useful framework for new technology". A study of attitudes to browser use found privacy and security were rated higher than functionality and usability (Mahinda and Whitworth, 2005). The results from this study have created a framework for Clinical IT in this research, which extends the privacy and security constructs.

4.5.1 Nature of This Research

Study III evaluated research hypotheses (Table 5.31) that sought the identification, on a small scale, of healthcare professionals' views and preferences with regards to information technology applications.

What is different about this research is that unlike other research in healthcare that focus primarily on one specific health care environment, a cross environment study has been conducted to develop a general, holistic view of healthcare professionals' expectations and perception, independent of the type and mode of applied healthcare activities. The process of questionnaire design and data collection was based on firstly identification of healthcare professionals requirements and secondly discovering potential discrepancies among various professionals in the health care industry.

Data was collected from various healthcare environments including teaching hospitals with medical and dental school affiliation, network hospital, clinics, and several solo and group physician practices. It is hoped that this research can serve as a stepping stone to identify and guide future research needs and directions in healthcare information technology system development.

4.5.2 Respondents' Demographics

Respondents' population is not a random sample population. It has very specifics attributes which has influenced the outcome of the findings to a large extent.
However, these respondents are not representative of the general population, they are fairly representative of the healthcare communities; and share a diverse functional mix within the specific domains. Lack of disparity among participating groups in some of the studies initially came cross, as unusual. However, after closely looking at the attributes of respondents' population, a homogenous population across all participating groups in terms of education, IT familiarity and appreciation. This prompted the researcher to re-examine, level of education, IT familiarity and experience and age group of the participants to better explain our findings.

Education: This is a highly educated population with approximately 95% having some college education, 89% at least a college degree, 50% master or higher degree. College education during last the 30 years has provided students with certain level of computer and technology related awareness and thus the level of education in this people presumes certain level of IT education.

IT Familiarity: It was an unexpected to learn that 90.5% of respondents have more than five years hands on experience with computers. Even more surprising was realizing that physicians (mean = 5.35) and non-physicians (mean = 4.90) healthcare providers have comparable years of hands on experience with computers as IT professionals did (mean = 5.52).

Age: As expected, all respondents are adults of working ages, and possibly due to the educational requirements, the youngest ones are in their mid twenties. Approximately 94% are below age 60 and 75% are below age 50.

Job Function: Approximately 93% of the respondents' population works in areas that require understanding and application of technology. These job functions include but not limited to (physicians, physicians assistant, nurses, Lab technicians, CIS, MIS, IT, etc). They view technology as an integrated part of their work and realize its enabling factors. Job functions of healthcare professional presume that a certain level of IT education, day to day exposure and application of information technology.

Respondents are employed in organizations that were deploying mobile cart in emergency rooms, involved in the deployment of electronic medical records, nursing working with in-house and outside vendors to understand the clinical requirements of operating departments. Large majority of non-technical staff surveyed are going back to college to earn advance degrees in areas such as clinical informatics, computer science and information technology to name a few.

The homogeneous texture of the respondent population is realized with respects to IT breadth and depth and this comes across when conducting group discrepancy analysis.

Age group, level of education combined with sophistication of job functions, portrays a technology aware population which has utilized IT both personally (Internet, email, cell phone, etc.) and workplace (data bases, notepads, Mobil devices, healthcare sophisticated equipments) to manage the challenges as well as basic activities of modern urban life. The perception of such an IT savvy population, regardless of the job function, identified as highly supportive and homogenous with a great deal of understating of expected benefits, required functionalities and adequate security.

Most of the differences among questionnaire items were flagged between group 4 "non-physician (other) healthcare professionals" and the three categories of respondents (physicians, IT professionals and Healthcare IT professionals). The obvious explanation is that group 4 constituents are characterized by more diversity in the sophistication their job functions, IT experience and knowledge and education. This explains much of the similarities among items and WOSP constructs as well as the level of IT adoption across participating groups.

The most important contribution of this research is the revelation that has challenged conventional belief that the healthcare community is resistant to IT in the work place; this may no longer be true based on these findings. It was discovered that physicians hold a positive perception toward the functionality of IT, believing that IT increases their effectiveness and overall competence; similarly IT professionals in health care share the belief that functionality of a system is essential to increase work effectiveness and efficiencies.

CHAPTER 5

DISCUSSION

5.1 Research Contribution

This chapter discusses the findings in respect to the empirical and exploratory expectations of this research effort. The major research contributions, limitations, implications and recommendations for future research are discussed.

In the previous chapter (4) a preliminary overview of the healthcare professionals' perception across various healthcare organizations, and functional groups were presented. The intention was to provide a top-level framework to further understand the healthcare community's needs and to suggest options for future customized information systems. However, this research and that of others (Sallas, Mathews, Watkins and Wiley-Patton, 2007; Kaplan et al., 2004) suggest that there is a long and challenging road ahead. An applied compliment to the present research will require advanced studies which elicit more detail and insight with regards to the software development criteria of health care information systems. A physician-centered health care information systems approach proposes to enhance the development criteria, improve the development processes and ultimately produce an IS product for healthcare that this research indicates would be more agreeable, efficient, effective, useful, secure, and practical to healthcare professionals.

5.2 Major Findings and Contributions

The results and contributions of this study are:

1. Unique to other healthcare researchers who focus primarily on one specific healthcare environment. The depth and breadth of this study has intersected healthcare and the information technology domains, as well as investigated diverse population groups within and across various healthcare facilities. Although the sample size was small, the diversity of the target audience has provided a richness in the findings that helps to shed light on the complexity of healthcare, information systems' development, perceptions and use in healthcare.

2. The design and development of a survey instrument with constructs that examine and measure the perceptions' of healthcare professions toward the adoption and use of electronic healthcare systems for clinical purposes.

3. The development of new constructs, specifically designed for the healthcare industry for an existing research model, the Web of System Performance model (WOSP) (Whitworth and Zaic, 2003, Hare, Whitworth, Deek and Norris, 2006). The inclusion of the exploratory constructs (Appendix C3) have helped to make the WOSP model applicable for predicting physicians' perceptions toward IT adoption for clinical purposes.

4. The revelation that the perception regarding the importance of IT security, medical record security, IT usefulness and usability of healthcare information systems reside at the very top level of the healthcare user community.

5. The identification of healthcare professionals' perceptions of integrated information systems and other IT initiatives in the clinical healthcare environment.

6. Exposing the prerequisite for IT adoption for clinical purposes; those are identification and standardization of healthcare information system requirements.

7. The realization that all of the groups investigated within this study found security as a necessary requirement for electronic health care systems.

8. Identifying the perception difference between physicians and IT professional in reference to the usability of electronic health care systems.

5.3 Discussion of Major Findings

In discussing the applicability of the research models, including the WOSP model, deployed in this study with regards to healthcare and information technology professionals' perceptions, attitudes, actual usage and outcomes of clinical information systems, analyses were conducted across several domains within the healthcare industry.

The four major functional areas deployed in study III included:

1. Clinical Healthcare Provider (Physicians)
2. Information Technology (IT) Professional
3. Healthcare Information Technology
4. Other Clinical Healthcare Provider (Non-Physicians)

Statistical test conducted for this research:

A. Cross Tabulations indicate adoption statistics for electronic health records in the clinical environment and the implications of the study (refer to Appendix F.5).

B. Data analysis starts with T-Tests that compare perception differences in participants and explore physicians' attitudes and perceptions regarding the existing systems analysis and design of clinical IT requirements. The statistical significance in the T-Test was mostly consistent with Mann-Whitney U Tests. However, the Mann-Whitney U Tests revealed a few more differences (refer to section 4.2 – 4.2.6).

C. The second set of statistical results are WOSP constructs which determine significance for clinical IT and the WOSP model, Mann-Whitney U Tests were used.

D. The four dimensions of the WOSP constructs have been verified through reliability tests. All presented a solid structure in terms of selection of their composing questionnaire items. A high Cronbach's Alpha >= .70 represents that all constructs items are measuring the same associated constructs.

- IT Adoption Construct with Cronbach's Alpha: .805
- Usefulness/Functionality Construct with Cronbach's Alpha: .729
- Usability Construct with Cronbach's Alpha: .858
- Security Construct with Cronbach's Alpha: .760

Based on study III results in part B, it was realized that participants in group number 2 (IT professionals) and 3 (healthcare information technology professionals) statistically represent the same population. That is, there were no statistical significant differences between those two groups among all questionnaire items. Therefore, to increase statistical sensitivity for the two groups involved in this statistical analysis, the researcher combined the two groups into one when WOSP constructs were built and data were analyzed (Appendix C.3) for clinical IT (security, usability, usefulness and IT adoption).

- Group 1- Clinical Healthcare Provider (Physicians)
- Group 2 - Information Technology (IT) Professionals (combined with group 3 Healthcare IT)
- Group 4 – Other Clinical Healthcare Provider (Non-Physicians)

The basic findings of this research can be deployed for further understating and provision of functions and criteria expected by the various participating groups. Healthcare systems have become more dependent on the application and deployment of IT. Such dependencies manifest at different levels of operation, functional areas, and urgency.

- Therefore, the IT requirements must be identified with adherence to the level of urgency, operation and functionality.
- After the identification, there is a scientific and economic need for standardization.
- The requirements of IT systems must by divided into functional areas, thoroughly identified and studied, and a plan for universal standardization must be provided to avoid duplication of work and ease of future developments.

Security Concerns: Security has been identified as a serious concern across all participating groups; therefore provision for security is at the center of healthcare information system design and development. Security is of importance particularly when databases have to be assessed for transferring electronic patient data (EHR) across servers.

5.4 Study III Hypotheses

These hypotheses were developed for the Web of System Performance constructs, listed below are the supported and rejected outcomes.

Table 5.31 Hypotheses.

Hypotheses	Supported	Rejected
Security (WOSP):		
H1: There is a perception difference between different groups of healthcare providers with respect to the importance of security in electronic healthcare systems.		X
H1a: There is a perception difference between Physicians and IT professional with respect to the importance of security in electronic healthcare systems.		X
H1b: There is a perception difference between other healthcare providers (non-physician) and IT professionals with respect to the importance of security in electronic health care systems.		X
H1c: There is a perception difference between other healthcare providers (non-physician) and physicians with respect to the importance of security in electronic health care systems.		X
Usability (WOSP):		
H2: There is a perception difference between Physicians and IT professionals with respect to the significance of electronic healthcare systems usability.	X	
H2a: There is a perception difference between other healthcare providers (non-physician) and IT professionals with respect to the significance of electronic healthcare systems usability.	X	
H2b: There is a perception difference between other healthcare providers (non-physician) and physicians with respect to the significance of electronic healthcare systems usability.	X	
H2c: There is a perception difference between other healthcare providers (non-physician) and physicians with respect to the significance of electronic healthcare systems usability.		X
Usefulness (WOSP):		
H3: There is a perception difference between different group of healthcare providers with respect to the significance and required functionality of electronic healthcare systems usability.		X
H3a: There is a perception difference between Physicians and IT professional with respect to the significance and required functionality of electronic healthcare systems usability.		X
H3b: There is a perception difference between other health care providers (non-physician) and IT professional with respect to the significance and required functionality of electronic healthcare systems usability.		X
H3c: There is a perception difference between other healthcare providers (non-physician) and physicians with respect to the significance and required functionality of electronic healthcare systems usability.		X
IT Adoption (WOSP):		
H4: There is a perception difference between different groups of healthcare providers with respect to their level of IT adoption.	X	
H4a: There is a difference between Physicians and IT professional with respect to their level of IT adoption.		X
H4b: There is a perception difference between other healthcare providers (non-physician) and IT professional with respect to their level of IT adoption.		X
H4c: There is a perception difference between other healthcare providers (non-physician) and physicians with respect to their level of IT adoption.	X	
H5: There exists a different perception between IT staff and clinical healthcare staff regarding tools required for clinical healthcare delivery (service and utilization).	X	
H6: The higher the level of perceived importance of security for an electronic healthcare system, the higher the level of IT adoption.	X	
H7: Level of IT knowledge is positively correlated with IT adoption.		X
H7a: As level of healthcare professional IT knowledge increases, their level of IT adoption increases as well.		X
H7b: As level of healthcare professional IT usage increases, their level of IT adoption increases as well.		X

5.5 Implications of Research

The adoption of IT by health care practitioners is being driven by E-Health advances, yet resistance to adopt IT for clinical purposes still exist. The adoption of clinical IT is still not widespread (Blumenthal, 2005). This study sheds some light on the reasons for such resistance. There, of course, a need to continue this type of investigation to further understand and address IT adoption and use in healthcare.

5.6 Implications

The overall implications of this study are as follows:

- Depth of study: across domains, within facilities, population grouping within healthcare organization has implication for advancing understanding about healthcare professional's perceptions and user requirements.
- Starting point for identification of the barriers to IT adoption and integration of clinical applications as it relates to information technology developers.
- Importance of security, usefulness and usability for electronic healthcare systems.
- Identification of requirements for the delivery of quality care for physicians and other healthcare providers of care.
- Recipients of medical care must have their patients' record private and secure.
- How healthcare and IT professionals can benefit from the results of the findings on perception and utilize them to advance IT integration and innovations within hospitals, clinics and physician practices.
- How to interconnect the IT solution (application) within the specific domain to existing applications.

5.7 Limitations

As with all research, the current study has some limitations.

Small sample size

- First, the study's sample was limited in size and medical specialty. This study had a total number of 86 respondents to the survey with a response rate of 75%. As such, the research would need to be replicated to examine the robustness of the findings across a larger sample size and a greater diversity of medical specialties. Second, while an effort was made to examine non-response bias, there is always the possibility that data are somehow systematically biased.

Field study as opposed to a lab experiment

- Emphasis should be place on focus groups prior to conducting the next round of field studies.
- Focus group will ensure unique users requirements are represented for the applicable domain being surveyed.

Methodological shortcomings

- Lack of customized questionnaires per respondent group.
- Lack of customization of the questionnaire lead to dropping variables with missing values.
- Standardize language on questionnaire to comply with the level of understanding of the participants within the specific domain and job function.

Need for a qualitative case study

- Identification of a study site that would consent to participating in a qualitative study over a specified period of time.

Healthcare professionals' unfamiliar with classic IT phrases and terminology

- Identify the specific nomenclature within each domain to ensure that similar terms and phrase are accounted for during data collection.

CHAPTER 6

CONCLUSION

The findings of this study suggest that people who work in the healthcare industry welcome the installation of integrated information systems. The participants in this study are highly educated and employed in environments where information technology has been greatly desired and highly appreciated. Little to no resistance to the introduction and adoption of these systems was seen from the healthcare professionals surveyed. The perceived information technology gap could not be directly related to any of the parameters measured. Contrary to anticipated results, many of the parameters measured were deemed of equal importance by all groups surveyed. However, it is not certain that each of the items was perceived by all groups in the same manner. It may be that these mutual misinterpretations of system constructs are most significant.

All groups identify information technology as essential to the healthcare profession. It is in the analysis of the differences of why they see IT as important that may be key to understanding. They all believe in functionality and effectiveness of the healthcare information systems. However, their understanding of the required tools and functionality is different. Physicians more than other groups emphasized ease of use, usefulness, compatibility and reliability in healthcare information systems while IT professionals simply believe that information technology systems will produce more efficiency to improve patient care.

The frameworks that have been evaluated and determined to be feasible for this healthcare dissertation all used the Technology Acceptance Model (TAM) and the Unified Model/TAM2 as a basis for this work. The factors that the qualitative research explored were intention and usage of information technology in a healthcare setting. The Technology Acceptance Model (TAM) has been the subject of robust research in most businesses for almost three decades. The TAM was devised to answer the question about the acceptance or rejection of information technology by the user community. Survey items in the questionnaire deployed for this dissertation used TAM2 perceived usefulness and perceived ease of use constructs that were modified to reflect the healthcare industry and Web of System Performance (WOSP) constructs.

The Web of System Performance is a combination of factors that are tied together to form an integrated approach for development. The WOSP model extends and integrates previous theories, including TAM, the general security model, and non-functional requirements research. None of these constructs is new; however, the constructs in this model (WOSP) demonstrate a balanced perspective that is new to the IS field. The WOSP framework uses four opportunity-increasing dimensions that are active (effectiveness, flexibility, openness, connectivity) and four failure–avoiding dimensions that are passive (security, reliability, privacy, usability). The results from this study aided in the creation of the framework for clinical IT in this research, which extends the privacy and security constructs. The project considered a different aspect of the WOSP model which incorporated the unique requirements of the healthcare environment, i.e., data mobility, security and confidentiality for potential clinical healthcare IT development. In most cases the survey questions presented did not delve into sufficient detail as to expose the crux of the constructs evaluated.

Security was identified as a serious concern across all participating groups surveyed and became a major requirement for healthcare information system design and development. Due to the confidential nature of medical data, features in healthcare information systems that insure data integrity and safety must be obvious to users and their patients. Additionally external requirements imposed by regulators further emphasize the need to maintain a high level of security. All the participating groups in this study rate security as important. But what is the definition of security for each group? Are healthcare professionals confusing privacy with security? An IT professional may define security parameters such as security of logon, password challenge questions, frequency of password changes, or VPN authorization, while healthcare professionals may consider locked doors, limited access, and regulations. Ultimately both groups have security as the goal, but with different pathways. Similarly with privacy concerns, are both groups asking the same questions about healthcare information systems? The patients' health records need to be limited. Is it merely a one to one relationship? Once authorized, what are the viewing privileges available? Where does viewing take place (on-site; intranet or internet access)? What is the time restriction on viewing privileges? What restrictions will the viewer have regarding copying or modifying the record being accessed? The difference again is in the details. Healthcare professionals view both privacy and security within the scope of their professional understanding. Security and privacy are often simply viewed as methods of preventing unauthorized access to a patient's records, but to the IT technology professional, it is much more.

Similar arguments can be made for the other WOSP constructs. From an information technology perspective, usefulness can be thought of as functionality. Systems would integrate seamlessly. Data structures would be common among manufacturers or translatable into a common interchange code. On the other hand, these details would not be considered by the healthcare professional. The totality of functionality would be the major concern. Will the system do the job in a cost effective manner? Will it allow the healthcare professionals to do their job more efficiently? Must the practice methods be amended to the software? Will the business change? Functionality is in the eye of the beholder. Agreement need be tempered in the detail. Reliability, a simplistic construct in the abstract, is a killer in detail. The design and maintenance of a system that operates seamlessly 24 hours a day with zero downtime for repair and maintenance is hardly considered by users. They are only interested in its always flawless, ever improving performance. Their argument for such a system is again its functionality. Whatever compromises had to be made when accepting the limitations of the system have been made part of their healthcare practice. Removal of that system without designed alternatives is not acceptable. No longer could a mere substitution take place as could be done with paper and pencil when either was worn out.

The conclusion that most effectively speaks to the gap in healthcare information technology is not resistance to change. The gap must be first examined in the complexity of the entire healthcare environment. This convoluted system is very information savvy, but the integration of the myriad of small systems within a massive bureaucracy makes it a nightmare for all but the most information technology and clinically astute. Information systems which can perform the most complex clinical procedures cannot communicate with many other systems in the hospital milieu. Similarly the operators of such systems, clinical and information professionals often have similar difficulty in communicating with each other. Most often, as this study suggests, it is not resistance to information technology but more likely a mutual misunderstanding of need. This can only be resolved in time by increasing the education of both clinicians and information scientists to the significant aspects of each other's professions.

APPENDIX OVERVIEW

The Appendix Overview is a chronological list of all documents that appear in subsequent order for Appendix A through Appendix H.

APPENDIX OVERVIEW

APPENDIX OVERVIEW
(Continued)

Appendix **Page**

APPENDIX OVERVIEW
(Continued)

Appendix **Page**

APPENDIX A

RESEARCH LETTERS

Appendix Sections A.1 to A.5 represents chronological letters that span from Study I through Study III.

APPENDIX A.1 INTRODUCTION LETTER STUDY I

Date: ____________________

CONSENT AND EXPLANATION OF RESEARCH PROJECT AT UMDNJ

TITLE OF RESEARCH: "A Qualitative Study Of The Diffusion Of Innovation Approach To Manage Change In Healthcare Organizations".

You have been asked to participate in a research study under the direction of Karen Hare, Ph.D. Candidate from New Jersey Institute of Technology, an Information Systems student in the College of Computing Sciences. Fadi Deek, Ph.D., Dean, College Of Science and Liberal Arts/Director Of Information Technology at NJIT's College of Computing Sciences, is the faculty co-advisor for this project.

The purpose of this study is to determine change associated with the introduction of Information Technology Systems into hospital operating departments. Your participation is limited to a brief set of questions. You will be one of approximately 50 participants in this study. There are no risks or discomforts associated with this research. There is no compensation available for your voluntary participation. There are no benefits to this study for you other than helping a Ph.D. student learn how to conduct research. I want to assure you that I have no hidden agenda, for example, such as an effort to evaluate the work of your group. The study may add to the knowledge researchers in the Information Technology field require, when determining how change is associated with the introduction of new Information Technology (IT) for healthcare organizations.

This questionnaire is anonymous. There is no way to identify your responses from those of other responders. This questionnaire does not have your name or other information that would identify you as answering the questions. If the findings from the study are published you will not be identified.

Your participation is voluntary and you may refuse to participate, or you may discontinue participating at any time, without penalty. Please be advised that "Consent to Participate", will be conducted without the presence of UMDNJ supervisory personnel, thereby allowing the participant the freedom to accept or decline without the felling of coercion. You may keep this letter describing the study.

If you have questions about this study please contact Karen Hare, (973) 687-1116 or email: kxh1868@njit.edu. You may contact the Chair of the Institutional Review Board, Dr. Cheryl Kennedy (973) 972-3608, for questions about your rights as a research subject.

Thank you for your time consideration.

Karen Hare, Ph.D. Candidate
Principal Investigator

APPENDIX A.2 ENTRÉE LETTER - STUDY II & INTRODUCTION LETTER - STUDY III

NJIT
New Jersey's Science & Technology University

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982

Date: ____________________

Dear __________:

You will recall we chatted on _____________. I indicated, then, that my research interest entails a study associated with the availability of Information Technology Systems in Clinical Healthcare environments. I will be testing a theory that attempts to explain the gap between what is developed by Information Technology (IT) departments and whether these IT initiatives are solving Clinical Healthcare Practitioners IT requirements. I want to discover whether applications that are developed are supporting Clinicians needs when implemented and adopted. To identify the kinds of structural problems that may develop in this transition and, particularly, the ways these problems are defined and managed. Naturally, I hope that you will find such a study to be both interesting to you and advantageous as you and your staff ponder and deal with some of the very same problems.

In so brief a note, it is not possible to provide greater detail on the study objectives, although I would be most pleased to discuss these further with you. Here, however, I wish to assure you that any future publication, which may result from this study, will fully generalize findings and mask the identities of persons and organizations for everyone's protection.

With your permission—and that of your co-professionals—I would spend a few weeks observing and listening for matters related to one's perception and system adoption. This means making it possible for me to gain access to staff meetings and other activities which might shed some light on specific events—access at my own discretion, although not without due regard to personal (staff or patient) and clinical requirements for privacy. Except for brief interviews (really conversations) I will not "make work" or otherwise complicate the efforts of your staff.

At later stages in the study, I will surely find one or another occasion to talk with the staff about some of my developing ideas; and surely at the conclusion of the study, I would be prepared to report to all the staff on findings pertinent to its interests. In this way, I hope my work would be of some value, and reciprocate your cooperation in the research project.

I will be phoning you within a few days, and would be happy to visit with you at any time thereafter for any matter you may wish to discuss with me prior to the start of the study.

Thank you for your time and consideration.

Karen Hare, Ph.D. Candidate
Principal Investigator

NJIT_Research_IntoLetter12_06

APPENDIX A.3 APPEAL LETTER 1 - STUDY III

NJIT
New Jersey's Science & Technology University

New Jersey Institute of Technology
University Heights
Newark, NJ 07102-1982
973.596.3677
973.565.0586 fax
emailcsla@njit.edu

COLLEGE OF SCIENCE & LIBERAL ARTS

Office of the Dean

IRB Protocol Numbers: 0120030027 and E07-03

Dear Doctor:

Information technology (IT) adds considerable value to modern organizations and healthcare is no exception. IT plays a major role in the financial viability of healthcare organizations however, while it is indispensable for healthcare administration, the penetration of IT for clinical purposes is very low. Research suggests physicians play a major part in the adoption, use and diffusion of IT in clinical settings (Institute Of Medicine, 2004). Today, physicians and healthcare administrators have a unique opportunity and challenge in which to collaborate on e-health initiatives in the United States that can improve computer and information systems integration in key clinical support areas (i.e. connecting physicians with patients, labs, hospitals, insurers, and pharmacies). Secure electronic communications and twenty-first century mobile devices can possibly make available critical healthcare information that is currently unavailable in the traditional paper-based health record.

As part of a larger study to assess the contribution of IT in healthcare, we are conducting a survey to explore physicians' attitudes and perceptions regarding the existing system analysis and design requirements of clinical IT. Our goal is to examine whether there is a *requirements' gap* between the perceptions of clinical IT designers/vendor, and the perceptions and needs of the clinical end-user.

Your participation will allow us to identify appropriate end-user requirements for mobile healthcare devices, while identifying the importance of matching the IT service provider and the healthcare receiver perspectives. Your expert knowledge and ideas are needed and greatly appreciated.

Please take ten minutes to complete the enclosed survey. Your response will remain confidential and data will only be used for statistical purposes. The study results will be available to you upon request. Should you have questions or concerns regarding our study, please contact: Dr. Fadi P. Deek at (973) 596 3677 or via email at **fadi.deek@njit.edu**.

We look forward to your valuable contribution.

Fadi P. Deek, Ph.D.
Dean and Professor of Information Systems and Mathematical Sciences
New Jersey Institute of Technology
College of Science and Liberal Arts

Sonja Wiley-Patton, Ph.D.
Professor of Information Systems & Decision Sciences
Louisiana State University
E. J. Ourso College of Business

APPENDIX A.4 APPEAL LETTER 2 - STUDY III

TRINITY
PEDIATRICS care dedication compassion
www.TrinityPediatrics.com
2333 Morris Avenue • Suite B218 • Union, New Jersey 07083
300 Chancellor Avenue • 2nd Floor • Newark, New Jersey 07112
T 908.810.8551
F 908.810.8661

Kia Calhoun Grundy, M.D., FAAP
Kerri Powell, M.D., FAAP

September 21, 2006

Dear Fellow Physician:

My name is Dr. Kerri Powell and I am a Pediatrician practicing in Union, New Jersey. I recently completed a research survey conducted by Dr. Wiley-Patton, and Dr. Deek of New Jersey Institute of Technology.

They are conducting research to study how medical technology can be successfully introduced and benefit the medical practice. Their hope is that by conducting this research that they will be able to provide practical information that will help physicians transition into the technology age. More and more medical practices are becoming technology based utilizing electronic medical record, PDA's and advanced medical software.

Your knowledge and ideas are needed. Please take a few minutes to complete and mail the enclosed survey. All individual returns will be confidential and the results of the study will be made available to you.

We look forward to your response.

Kerri Powell, MD

APPENDIX A.5 EXPLANATION OF RESEARCH/STUDY III

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982

January 2007

EXPLANATION OF RESEARCH PROJECT

You have been asked to participate in a research study under the direction of Karen Hare, Ph.D. Candidate from New Jersey Institute of Technology, an Information Systems student in the College of Computing Sciences. Fadi Deek, Ph.D. and Dean at NJIT College of Liberal Arts and Sciences and Sonja Wiley-Patton, Ph.D. and Professor at Louisiana State University are the faculty co-advisors for this project.

The purpose of this study is to determine the perception gap between Clinical Healthcare Providers/Practitioners and the Information Technology Department; as to the utility of Healthcare Information Technology Applications that are implemented and adopted within healthcare organizations.

Your participation is limited to a brief set of questions. You will be one of approximately 135 plus participants in this study. There are no risks or discomforts associated with this research. There is no compensation available for your voluntary participation. There are no benefits to this study for you other than helping a Ph.D. student learn how to conduct research. I want to assure you that I have no hidden agenda, for example, such as an effort to evaluate the work of your group. The study may add to the knowledge researcher in the Information Technology field require, when determining how change is associated with the introduction of new Information Technology (IT) for healthcare organizations.

This questionnaire is anonymous. There is no way to identify your responses from those of other responders. This questionnaire does not have your name or other information that would identify you as answering the questions. If the findings from the study are published you will not be identified.

Your participation is voluntary and you may refuse to participate, or you may discontinue participating at any time, without penalty. Please be advised that "Consent to Participate", will be conducted without the presence of Supervisory personnel, thereby, allowing the participant the freedom to accept or decline without the felling of coercion. You may keep this letter describing the study.

If you have questions about this study please contact Karen Hare, (973) 687-1116 or email: kxh1868@njit.edu or Dr. Fadi Deek at deek@njit.edu. You may contact the Chair of the Institutional Review Board at NJIT, Dawn Hall Apgar, PhD, LSW, ACSW at (973) 642-7616, for questions about your rights as a research subject.

I thank you for taking time from your busy schedule to completing this survey.

Karen Hare, Ph.D. Candidate
Principal Investigator

njit_intro_07.doc

APPENDIX B

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Appendix Sections B.1 to B.5 represent chronological consent letters for Study I through Study III.

APPENDIX B.1 CONSENT TO PARTICIPANT IN STUDY I

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: **A Qualitative Study Of The Diffusion Of Innovation Approach To Manage Change In Healthcare Organizations.**

RESEARCH STUDY:

> I,____, have been asked to participate in a research study under the direction of **Karen Hare.** Other professional persons who work with them as study staff may assist to act for them.

PURPOSE: **To determine the level of acceptance/resistance & change associated with the introduction of Information Technology into Operating Departments of healthcare organizations.**

DURATION: My participation in this study will last for a **maximum of 1 – 3 hours**.

PROCEDURES: I have been told that, during the course of this study, the following will occur: **I will be given a questionnaire; and observed during normal computer task(s).**

PARTICIPANTS: I will be one of about **50 participants** to participate in this trial.

EXCLUSIONS: I will inform the researcher if any of the following apply to me:

RISK/DISCOMFORTS: I have been told that the study described above may involve the following risks and/or discomforts: **None anticipated other than the normal response to being interviewed and observed.**

There also may be risks and discomforts that are not yet known. **None anticipated other than the normal response to being interviewed and observed.**

I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by

NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

CONFIDENTIALITY: Every effort will be made to maintain the confidentiality of my study records. Officials of NJIT will be allowed to inspect sections of my research records related to this study. If the findings from the study are published, I will not be identified by name. My identity will remain confidential unless disclosure is required by law.

PAYMENT FOR PARTICIPATION: I have been told that I will not receive **any** compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW: I understand that my participation is voluntary and I may refuse to participate, or I may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT: If I have any questions about my treatment or research procedures that I discuss them with the principal investigator. If I have any addition questions about my rights as a research subject, I may contact:

Richard Greene, M.D., Ph.D., Chair, IRB (973) 596-3281

APPENDIX B.2 CONSENT TO PARTICIPATE IN STUDY II

NJIT
New Jersey's Science & Technology University

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"

RESEARCH STUDY:

I, ____, have been asked to participate in a research study under the direction of **Karen Hare.** Other professional persons who work with them as study staff may assist or act for them.

PURPOSE: To determine the perception gap between Clinical Healthcare Providers/Practitioners and the Information Technology Department as to the utility of Healthcare Information Technology Applications that are implemented and adopted within healthcare organizations.

DURATION: My participation in this study will last for a **Maximum of 1 – 3 hours**.

PROCEDURES: I have been told that, during the course of this study, the following will occur: **I will be given a questionnaire; participate in a focus group that will be audio taped and observed during normal computer task(s).**

PARTICIPANTS: I will be one of about **135 participants** to participate in this trial.

EXCLUSIONS: I will inform the researcher if any of the following apply to me:

RISK/DISCOMFORTS: I have been told that the study described above may involve the following risks and/or discomforts: **None anticipated other than the normal response to being interviewed and observed.**

There also may be risks and discomforts that are not yet known. **None anticipated other than the normal response to being interviewed and observed.**

(Pg. 2)

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"

I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

CONFIDENTIALITY: Every effort will be made to maintain the confidentiality of my study records. Officials of NJIT will be allowed to inspect sections of my research records related to this study. If the findings from the study are published, I will not be identified by name. My identity will remain anonymous unless disclosure is required by law. Please note: **no personal health information** will be collected for this research.

If I do not sign this approval form, I will not be able to take part in this research study.

PAYMENT FOR PARTICIPATION: I have been told that I will not receive **any** compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW: I understand that my participation is voluntary and I may refuse to participate, or I may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT: If I have any questions about my treatment or research procedures I can discuss them with the principal investigator, Karen Hare, (973) 687-1116 or email: kxh1868@njit.edu. You may contact the Chair of the Institutional Review Board at NJIT, Dawn Hall Apgar, PhD, LSW, ACSW at (973) 642-7616, for questions about your rights as a research subject.

____

(Signature)

APPENDIX B.3 UMDNJ CONSENT TO PARTICIPATE IN STUDY II

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"

RESEARCH STUDY:

I, ____, have been asked to participate in a research study under the direction of **Karen Hare.** Other professional persons who work with them as study staff may assist or act for them.

PURPOSE: **To determine the perception gap between Clinical Healthcare Providers/Practitioners and the Information Technology Department as to the utility of Healthcare Information Technology Applications that are implemented and adopted within healthcare organizations.**

DURATION: My participation in this study will last for a **maximum of 1 – 3 hours**.

PROCEDURES: I have been told that, during the course of this study, the following will occur: **I will be given a questionnaire; participate in a focus group that will be audio taped and observed during normal computer task(s).**

PARTICIPANTS: I will be one of about **135 participants** to participate in this trial.

EXCLUSIONS: I will inform the researcher if any of the following apply to me:

RISK/DISCOMFORTS: I have been told that the study described above may involve the following risks and/or discomforts: **None anticipated other than the normal response to being interviewed and observed.**

There also may be risks and discomforts that are not yet known. **None anticipated other than the normal response to being interviewed and observed.**

I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"

CONFIDENTIALITY:
In addition to key members of the research team, the following people will be allowed to inspect parts of my medical record and my research records related to this study:
The Institutional Review Board (a committee that reviews research studies)
Officials of the University of Medicine and Dentistry of New Jersey
Office for Human Research Protections (OHRP) (regulatory agency that oversees human subject research)

By taking part of this study, I should understand that the study collects demographic data and data on my health. This data will be recorded by the study doctor/investigator who may store and process my data with electronic data processing systems. The data will be kept as long as the study is being conducted and for <u>6 years.</u>

My personal identity, that is my name, address, and other identifiers, will be kept confidential. I will have a code number and my actual name will not be used. Only my study doctor will be able to link the code number to my name and will keep this information for <u>6 years</u>. My data may be used in scientific publications. If the findings from the study are published, I will not be identified by name. My identity will be kept confidential. **If I do not sign this approval form, I will not be able to take part in this research study.**

I can change my mind and revoke this approval at any time. If I change my mind, I must revoke my approval in writing. Beginning on the date that I revoke my approval, no new personal health information will be used for research. However, the study doctor/investigator may continue to use the health information that was provided before I withdrew my approval.

The wording in this consent is standard language required by the Institutional Review Board (IRB) at UMDNJ. **Please note: <u>no personal health information</u> will be collected for this research.**

PAYMENT FOR PARTICIPATION: I have been told that I will not receive <u>any</u> compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW: I understand that my participation is voluntary and I may refuse to participate, or I may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT: If I have any questions about my treatment or research procedures I can discuss them with the principal investigator, Karen Hare, (973) 687-1116 or email: kxh1868@njit.edu. You may contact the Chair of the Institutional Review Board at UMDNJ, Cheryl Kennedy, M.D. (973) 972-3608 or Mark Long, MPA, Director, IRB for questions about your rights as a research subject.

____
(Signature)

APPENDIX B.4 CONSENT TO PARTICIPATE IN STUDY III

NEW JERSEY INSTITUTE OF TECHNOLOGY
323 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: **A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"**

RESEARCH STUDY:

I, ______________________________________, have been asked to participate in a research study under the direction of **Karen Hare.** Other professional persons who work with them as study staff may assist or act for them.

PURPOSE: **To determine the perception gap between Clinical Healthcare Providers/Practitioners and the Information Technology Department as to the utility of Healthcare Information Technology Applications that are implemented and adopted within healthcare organizations.**

DURATION: My participation in this study will last for a **maximum of 1 hour**.

PROCEDURES: I have been told that, during the course of this study, the following will occur: **I will be given a questionnaire to complete and be observed while completing normal computer task(s).**

PARTICIPANTS: I will be one of about **135 participants** to participate in this research.

EXCLUSIONS: I will inform the researcher if any of the following apply to me:

RISK/DISCOMFORTS: I have been told that the study described above may involve the following risks and/or discomforts: **None anticipated other than the normal response to being interviewed and observed.**

There also may be risks and discomforts that are not yet known. **None anticipated other than the normal response to being interviewed and observed.**

I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"

CONFIDENTIALITY: Every effort will be made to maintain the confidentiality of my study records. Officials of NJIT will be allowed to inspect sections of my research records related to this study. If the findings from the study are published, I will not be identified by name. My identity will remain anonymous unless disclosure is required by law. Please note: **no personal health information** will be collected for this research.

If I do not sign this approval form, I will not be able to take part in this research study.

PAYMENT FOR PARTICIPATION: I have been told that I will not receive **any** compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW: I understand that my participation is voluntary and I may refuse to participate, or I may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT: If I have any questions about my treatment or research procedures I can discuss them with the principal investigator, Karen Hare, (973) 687-1116 or email: kxh1868@njit.edu. You may contact the Chair of the Institutional Review Board at NJIT, Dawn Hall Apgar, PhD, LSW, ACSW at (973) 642-7616, for questions about your rights as a research subject.

MAIL OR FAX SIGNED CONSENT FORM: In an effort to strengthen the anonymity and confidentiality agreement stated please use the pre-paid stamped envelope provided; Mail or **Fax** your signed consent form to :

Dr. Fadi P. Deek
New Jersey Institute of Technology
College of Science and Liberal Arts
323 Martin Luther King Blvd.
University Heights
Newark, NJ 07102-1982
Fax: (973) 565-0586

____

(Signature)

APPENDIX B.5 UMDNJ CONSENT TO PARTICIPATE IN STUDY III

NEW JERSEY INSTITUTE OF TECHNOLOGY
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus?"

RESEARCH STUDY:

I, ____, have been asked to participate in a research study under the direction of **Karen Hare.** Other professional persons who work with them as study staff may assist or act for them.

PURPOSE: **To determine the perception gap between Clinical Healthcare Providers/Practitioners and the Information Technology Department; as to the utility of Healthcare Information Technology Applications that are implemented and adopted within healthcare organizations.**

DURATION: My participation in this study will last for a **Maximum of 1 hour**.

PROCEDURES: I have been told that, during the course of this study, the following will occur: **I will be given a questionnaire and observed during normal computer task(s).**

PARTICIPANTS: I will be one of about **135 participants** to participate in this trial.

EXCLUSIONS: I will inform the researcher if any of the following apply to me:

RISK/DISCOMFORTS: I have been told that the study described above may involve the following risks and/or discomforts: **None anticipated other than the normal response to being interviewed and observed.**

There also may be risks and discomforts that are not yet known. **None anticipated other than the normal response to being interviewed and observed.**

I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

(Pg. 2)

TITLE OF STUDY: A Qualitative Study To Address, "Why The Adoption Of Information Technology Is Lower In Clinical Healthcare Than Other Healthcare Milieus"

CONFIDENTIALITY:
In addition to key members of the research team, the following people will be allowed to inspect parts of my medical record and my research records related to this study:

- The Institutional Review Board (a committee that reviews research studies)
- Officials of the University of Medicine and Dentistry of New Jersey
- Office for Human Research Protections (OHRP) (regulatory agency that oversees human subject research)

By taking part of this study, I should understand that the study collects demographic data and data on my health. This data will be recorded by the study doctor/investigator who may store and process my data with electronic data processing systems. The data will be kept as long as the study is being conducted and for 6 years.

My personal identity, that is my name, address, and other identifiers, will be kept confidential. I will have a code number and my actual name will not be used. Only my study doctor will be able to link the code number to my name and will keep this information for 6 years. My data may be used in scientific publications. If the findings from the study are published, I will not be identified by name. My identity will be kept confidential. **If I do not sign this approval form, I will not be able to take part in this research study.**

I can change my mind and revoke this approval at any time. If I change my mind, I must revoke my approval in writing. Beginning on the date that I revoke my approval, no new personal health information will be used for research. However, the study doctor/investigator may continue to use the health information that was provided before I withdrew my approval.

The wording in this consent is standard language required by the Institutional Review Board (IRB) at UMDNJ. Please note: **no personal health information** will be collected for this research.

PAYMENT FOR PARTICIPATION: I have been told that I will not receive **any** compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW: I understand that my participation is voluntary and I may refuse to participate, or I may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT: If I have any questions about my treatment or research procedures I can discuss them with the principal investigator, Karen Hare, (973) 687-1116 or email: kxh1868@njit.edu. You may contact the Chair of the Institutional Review Board at UMDNJ, Paula Bistak, RN, MS, CIP, (973) 972-3608 or Mark Long, MPA, Director, IRB for questions about your rights as a research subject.

____

(Signature)

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3_3_07

APPENDIX C

RESEARCH SURVEYS

Appendix Sections C.1 to C.5 represent chronological research surveys that span from Study I through Study III.

APPENDIX C.1 SURVEY 1 - STUDY I

UMDNJ/NJIT
Diffusion Of Innovation Approach To Manage Change In Healthcare Organizations

Please assist in this research project by answering all of the following questions. Fill in or circle your answer for questions 1 - 9.

1. What department are you in? ______________________________
2. Name of the System you are using: ___________________________
3. Sex: (a). Female or (b). Male
4. Number of years at UMDNJ? (a). Less than 1 year (b). 1- 5 years (c). 6-10 years (d). 11-15 years (e). 15 or more years
5. Are you: (a). Management (b). Administration (c). Nursing Staff (d). Support Staff
6. Number of years of computer usage? (a). Less than 1 year (b). 1- 5 years (c). 6-10 years (d). 11-15 years (e). 15 or more years
7. What is your educational background? (a). High School (b). Some College (c). College Degree (d). Masters Degree (e). Ph.D. Degree (f). M.D.
8. How often do you use the Hospital (or Clinic) computer system? (a). Less than an hour per day. (b). One to three hours per day. (c). Most of the day. (d). The entire day.
9. On a scale of one to seven, circle the response that most accurately describes your evaluation of the Hospital Computer Information System?

Simple --------1--------2--------3--------4--------5--------6--------7-------- Complex

Friendly -------1--------2--------3--------4---------5-------6--------7---------Unfriendly

Easy--------1---------2----------3---------4--------5--------6---------7--------Difficult

Hindering-------1-------2-------3--------4--------5--------6--------7-------Helpful

Threatening------1--------2--------3--------4--------5-------6--------7------Unthreatening

Circle the response that best describes how you feel about the Hospital Computer Information System for questions 10- 17.

(SA: Strongly Agree, A: Agree, N: Neutral, D: Disagree, SD: Strongly Disagree)

10. There were times when I wanted to use a feature that did not exist.
SA-----------------A----------------N----------------D----------------SD

11. I found the screen layout easy to understand.
SA-----------------A----------------N----------------D----------------SD

12. The system is clearly designed and easy to follow.
SA-----------------A----------------N----------------D----------------SD

13. I understood the terminology that was used?
SA-----------------A----------------N----------------D----------------SD

14. I felt that there was a logical sequence to the data entry process.
SA-----------------A----------------N----------------D----------------SD

15. I prefer to use paper and pencil instead of a computer system.
SA-----------------A----------------N----------------D----------------SD

16. I would recommend this system to my friends?
SA-----------------A----------------N----------------D----------------SD

17. If you could change this system, what kinds of features would you add or delete?

____

____

____

____

____

Thank you for your help with this research project. For questions, contact Karen Hare, (973) 687-1116

Questionnaire.doc
4/2003

APPENDIX C.2: COVER SHEET: SURVEY II - STUDY II

NJIT
New Jersey's Science & Technology University

Date: ____________

___ Clinical Healthcare Provider
___ Information Technology
___ Healthcare Information Technology

Please Tell Us About Yourself

1. What is your primary specialty? ____________________

2. If applicable, what is your sub-specialty? ____________________

3. Gender: Male Female (Circle One)

4. What is your age group? **20-30** **31-40** **41-50** **51-60** **61+** (Circle One)

5. Are you a member of? (Check applicable box)

Medical Staff	Administration	Management	IT or MIS	Nursing	Support Staff	Other

6. Number of years experience in the Clinical Healthcare field?

Less than 1 year	1 – 3 years	4 -6 years	6 – 10 years	11 – 15 years	15 plus	Other

7. Number of years experience in the Information Technology field?

Less than 1 year	1 – 3 years	4 -6 years	6 – 10 years	11 – 15 years	15 plus	Other

8. What is your highest educational background?

High School	Some College	College Degree	Masters Degree	Physician	Doctorate Degree	Medical Student

9. How many years of hands-on experience do you have with computers?

None	1 – 3 years	4 -6 years	6 – 10 years	11 – 15 years	15 plus	Other

10. How knowledgeable do you consider yourself to be about the following:

Environment	Novice	Slightly	Moderate	Very	Expert
Information Technology Industry					
Clinical Healthcare Industry					
Healthcare Industry					

APPENDIX C.3 SURVEY II - STUDY II

NJIT
New Jersey's Science & Technology University

The Adoption of Information Technology in Clinical Healthcare

Please place a check mark in the box that indicates your response about Information Technology access for questions 1 – 9.

1. In Clinical Healthcare, how important is it to have immediate access to information?

Not Significant	Slightly	Somewhat	Significant	Very Significant	Not Sure

2. How often do you use a computer information system when completing daily tasks?

Environment	Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day
Clinical Healthcare							
Information Technology							

3. Approximately what percentage of the information support in Clinical Healthcare comes from computer information system?

None	0 – 19%	20% - 39%	40% - 59%	60% - 79%	80% - 90%	100%

4. In the following settings, how often do you use a Personal Digital Assistant (PDA)?

Environment	Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day
Clinical Healthcare							
Information Technology							

5. In a clinical healthcare setting, how often do you use the following?

Technology	Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day
Tablet							
Laptop							
Desktop PC							
Mobile Cart							
Other							

The Adoption of Information Technology in Clinical Healthcare

6. In an information technology setting, how often do you use the following?

Technology	Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day
Tablet							
Laptop							
Desktop PC							
Mobile Cart							
Other							

7. If access to another type of information technology equipment occurs in a clinical healthcare setting, please explain.

____

____

8. For clinical healthcare providers who desire fast access to patient information, what size computerized tool would you want?

Cell Phone	Handheld (PDA)	Tablet	Laptop	Desktop PC	Mobil Cart

9. For clinical healthcare providers who desire computerized tools for access to information technology, what would be the largest size device you would be willing to carry?

Cell Phone	Handheld (PDA)	Tablet	Laptop	Desktop PC	Mobil Cart

On a scale of 1 (least important) through 7 (most important), please circle the response that best describes your opinion about your current clinical healthcare system for questions 10- 13.

10. If your current manual system (pen/paper) were converted to a computer information system, how would the change affect the tasks of delivering clinical healthcare services?

(a)	More Secure	----7------6------5------4------3------2------1----	Less Secure
(b)	Friendly	----7------6------5------4------3------2------1----	Unfriendly
(c)	Easy to Use	----7------6------5------4------3------2------1----	Difficult to Use
(e)	Private (within the Organ.)	----7------6------5------4------3------2------1----	Public (outside the Organ.)
(f)	Useful	----7------6------5------4------3------2------1----	Not Useful
(g)	Compatible	----7------6------5------4------3------2------1----	Individualist
(h)	Reliable	----7------6------5------4------3------2------1----	Unreliable

The Adoption of Information Technology in Clinical Healthcare

11. In a computerized clinical healthcare system with checks and balances for dealing with patient prescriptions, ordering tests and reporting correct data would have to be:

(a)	More Secure	----7------6------5------4------3------2------1----	Less Secure
(b)	Friendly	----7------6------5------4------3------2------1----	Unfriendly
(c)	Easy to Use	----7------6------5------4------3------2------1----	Difficult to Use
(e)	Private (within the Organ.)	----7------6------5------4------3------2------1----	Public (outside the Organ.)
(f)	Useful	----7------6------5------4------3------2------1----	Not Useful
(g)	Compatible	----7------6------5------4------3------2------1----	Individualist
(h)	Reliable	----7------6------5------4------3------2------1----	Unreliable

12. What would be required for you to use a wireless network connection to transmit patient information in clinical healthcare?

(a)	More Secure	----7------6------5------4------3------2------1----	Less Secure
(b)	Friendly	----7------6------5------4------3------2------1----	Unfriendly
(c)	Easy to Use	----7------6------5------4------3------2------1----	Difficult to Use
(e)	Private (within the Organ.)	----7------6------5------4------3------2------1----	Public (outside the Organ.)
(f)	Useful	----7------6------5------4------3------2------1----	Not Useful
(g)	Compatible	----7------6------5------4------3------2------1----	Individualist
(h)	Reliable	----7------6------5------4------3------2------1----	Unreliable

13. In order to have secure and confidential data for a clinical healthcare system, what would these applications require for your use?

(a)	More Secure	----7------6------5------4------3------2------1----	Less Secure
(b)	Friendly	----7------6------5------4------3------2------1----	Unfriendly
(c)	Easy to Use	----7------6------5------4------3------2------1----	Difficult to Use
(e)	Private (within the Organ.)	----7------6------5------4------3------2------1----	Public (outside the Organ.)
(f)	Useful	----7------6------5------4------3------2------1----	Not Useful
(g)	Compatible	----7------6------5------4------3------2------1----	Individualist
(h)	Reliable	----7------6------5------4------3------2------1----	Unreliable

The Adoption of Information Technology in Clinical Healthcare

Please place a check mark in the box that indicates your response.

14. To what degree are current software applications developed and programmed by an in-house information technology department?

None	0 – 19%	20% - 39%	40% - 59%	60% - 79%	80% - 90%	100%

15. To what degree are current software applications proprietary (i.e., purchased from outside vendors)?

None	0 – 19%	20% - 39%	40% - 59%	60% - 79%	80% - 90%	100%

Please indicate a numerical value based on the following scale of 1 to 7, with 1 (lowest value) indicating 'Never' and 7 (the highest value) indicating 'All the time'.

16. When developing new computer information systems for clinical healthcare, to what degree have healthcare professionals in your department/organization been consulted?

Not Consulted At All	Administration	Management	Departmental	Supervisory	Users	Fully Consulted At All Levels

The Adoption of Information Technology in Clinical Healthcare

Please place a check mark in the box with the response that best describes how you feel about the adoption of a clinical information system for questions 17 - 29.

	Strongly Agree	Agree	Agree Slightly	Neutral	Disagree Slightly	Disagree	Strongly Disagree
17. Cost has been a significant factor in preventing the adoption of information technology for clinical healthcare applications in my organization.							
18. Clinical healthcare systems developed by an in-house information technology department are able to be integrated into existing organizational applications							
19. New applications have the ability to be modified and/or upgraded when information requirements change.							
20. If you are not using information technology for clinical healthcare systems, you believe adding this technology will increase productivity.							
21. The time it takes to complete daily tasks would decrease with the introduction of computerized clinical healthcare systems.							
22. Using computerized clinical healthcare systems would increase the time it takes to complete daily clinical tasks.							
23. Confidentiality is a major factor in determining information technology requirements for clinical healthcare systems.							
24. Security is a major factor in determining clinical healthcare information technology requirements for clinical healthcare systems.							
25. A computerized clinical healthcare system would produce useful patient data.							
26. Using a wireless network connection to transmit patient information creates a privacy risks.							
27. There is a need for computerization of patient health records.							
28. Maintaining a secure environment for patient records is very important.							
29. Maintaining computerized patient health records would decrease medical errors.							

The Adoption of Information Technology in Clinical Healthcare

Please fill in your responses for questions 30 -36.

30. If proprietary software is purchased, what are the security requirements designated for the vendor when confidential data has to be accessed for development?

____
____
____

31. What measures have you undertaken to keep patient health records confidential?

____
____
____

32. What other issues can you discuss that have impacted your confidentiality/privacy requirements?

____
____
____
____

33. What is the name and location of the medical school you attended?

____
____
____
____

34. What year did you graduate? _______________

35. Did your medical school have an Information Technology curriculum? **Yes** **No**

36. If you have had Information Technology education or training please indication:

____
____
____
____

APPENDIX C.4 COVER SHEET SURVEY III- STUDY III

NJIT
New Jersey's Science & Technology University

Date: ________

____ Clinical Healthcare/Provider
____ Information Technology (IT)
____ Healthcare Information Technology

Please Tell Us About Yourself

1. What is your primary job description? ____________________

2. If applicable, do you have a secondary job description? ____________________

3. Gender: Male Female **(Circle One)**

4. What is your age group? **20-30 31-40 41-50 51-60 61+ (Circle One)**

5. Are you a member of? **(Check applicable box)**

Medical Staff	Admin/Mgmt	CIS	MIS	IT	Nursing	Support Staff

Other, explain ____________________

6. Number of years experience in the following setting (**Select the one that is applicable for you**).

Environment	Less than 1 year	1 – 3 years	4 -5 years	6 – 10 years	11 – 15 years	15 plus
Clinical Healthcare Field						
Information Technology (IT) Field						

7. Please indicate your highest educational achievement.

High School	Some College	College Degree	Masters Degree	Physician	Doctoral Degree	Medical Student

8. How many years of hands-on experience do you have working with computers?

None	Less than 1 year	1 – 3 years	4 -5 years	6 – 10 years	11 – 15 years	15 plus

9. How knowledgeable do you consider yourself to be about the following?

Environment	Novice	Slightly	Moderate	Very	Expert
Information Technology					
Clinical Healthcare					
Healthcare Industry					

Please Tell Us About Yourself

For Physicians, please fill in your response for questions 10 - 13.

10. What is the name and location of the Medical School you attended?

____
____
____
____

11. What year did you graduate? _________________________

12. Did your Medical School have an Information Technology curriculum? **Yes** **No**

13. If you have had Information Technology education or training, please indicate?

____
____
____
____

APPENDIX C.5 SURVEY III - STUDY III

NJIT
New Jersey's Science & Technology University

Adopting an Electronic Health Record in Clinical Healthcare

Please place a check mark in the box or write your response for questions 1 – 7.

1. How often do you use a computer information system when completing daily tasks?

Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day

2. In your professional setting how often do you use a Personal Digital Assistant (PDA)? (**Circle your applicable frequency**).

Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day

3. How often do you use the following? (**Check all that are applicable**).

Technology & Mobile Tools	Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day
Handheld (PDA)							
Tablet Computer							
Laptop							
Desktop PC							
Mobile Cart							
Other							

Please fill in your responses:

4. If you have access to another type of information technology equipment (other than the above), in a clinical healthcare setting, please identify and explain how you use it.

____

____

____

____

5. What would be the largest size mobile device you would be willing to carry?

Cell Phone	Handheld (PDA)	Tablet Computer	Laptop

Adopting an Electronic Health Record in Clinical Healthcare

Please place a check mark in the box that indicates your response.

6. In your work environment, to what degree are current software applications developed and programmed by an **in-house** Information Technology department?

None	0 – 19%	20% - 39%	40% - 59%	60% - 79%	80% - 90%	100%

7. In your work environment, to what degree are current software applications proprietary (i.e., purchased from **outside vendors**)?

None	0 – 19%	20% - 39%	40% - 59%	60% - 79%	80% - 90%	100%

Please place a check mark in the box or write your response for questions 8 –13, that explains how you feel about the adoption of an Electronic Health Record (EHR) system for Clinical Healthcare.

8. In clinical healthcare, how important is it to have immediate access to information?

Very Significant	Significant	Slightly Significant	Neutral	Not Significant	Not Sure

9. If you were considering an electronic device for accessing patient information, what kind of computerized tool would you prefer? **(Please choose one)**.

Handheld (PDA)	Tablet Computer	Laptop	Desktop PC	Mobile Cart

10. Approximately what percentage of medical records in your practice comes from an EHR system?

None	0 – 19%	20% - 39%	40% - 59%	60% - 79%	80% - 90%	100%

11. Please indicate the type of practice you work in.

Solo Practice	Group Practice	Clinic	Hospital	Hospital Chain

Adopting an Electronic Health Record in Clinical Healthcare

12. Please indicate the approximate number of medical records in your system.

1 - 999	1,000 - 9,999	10,000 - 99,999	Greater Than 100,000

Please indicate a numerical value based on the following scale of 0 to 4, with 0 (not consulted) and 4 (fully consulted).

13. When considering an EHR system for your practice or institution, to what degree have the following been consulted?

Administration/Management	Clinical Records Department	Departmental/Supervisory	Users

On a scale of 1 (least important) through 7 (most important), please circle the response that describes your opinion about computerized requirements for question 14.

14. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have:

(a)	Highest Security	-----7-----6-----5-----4-----3-----2-----1-----	None
(b)	Friendliness	-----7-----6-----5-----4-----3-----2-----1-----	Unfriendliness
(c)	Ease of Use	-----7-----6-----5-----4-----3-----2-----1-----	Difficulty of Use
(d)	Private Access (Internal within the Organ., e.g., Intranet)	-----7-----6-----5-----4-----3-----2-----1-----	Public Access (External to the Organ. e.g., Internet)
(e)	Usefulness	-----7-----6-----5-----4-----3-----2-----1-----	No Usefulness
(f)	Compatibility	-----7-----6-----5-----4-----3-----2-----1-----	Non-Compatibility
(g)	Reliability	-----7-----6-----5-----4-----3-----2-----1-----	Unreliability

Please fill in your response:

15. What standards/requirements have your organization established to keep patients' EHR's private?

____

____

____

Adopting an Electronic Health Record in Clinical Healthcare

For questions 16 –27, please place a check mark in the box with the response that explains how you feel about the adoption of an Electronic Health Record (EHR) system for Clinical Healthcare.

	Strongly Agree	Agree	Agree Slightly	Neutral	Disagree Slightly	Disagree	Strongly Disagree
16. Cost has been a significant factor in preventing the adoption of an electronic health record (EHR) system for clinical healthcare in my organization.							
17. Clinical healthcare systems developed by an **in-house** Information Technology department are able to be integrated into existing organizational applications.							
18. New applications have the ability to be modified and or upgraded when information requirements change.							
19. If I am not using an EHR system, I believe that adding this technology will increase productivity.							
20. The time it takes to complete daily tasks will decrease with the introduction of computerized electronic health records.							
21. Using computerized clinical healthcare systems will increase the time it takes to complete daily clinical tasks.							
22. Confidentiality is a major factor in determining information technology requirements for electronic health records.							
23. Security is a major factor in determining information technology requirements for EHR.							
24. A computerized clinical healthcare system will produce useful patient data.							
25. Using a wireless network connection to transmit patient information will create privacy risks.							
26. There is a need for computerization of patient health records.							
27. Maintaining a secure environment for patient records is very important.							

Adopting an Electronic Health Record in Clinical Healthcare

For questions 28 – 41, please place a check mark in the box with the response that explains how you feel about the adoption of an integrated computer system for Clinical Healthcare.

	Strongly Agree	Agree	Agree Slightly	Neutral	Disagree Slightly	Disagree	Strongly Disagree
28. Maintaining computerized patient electronic health records (EHR) decreases medical errors.							
29. A personal digital assistant (PDA) will let me complete EHR tasks more efficiently.							
30. PDA's will have an interface that is easy to use.							
31. Training in the usage of PDA's will not be required; I will be able to use the tool immediately.							
32. Productivity will be increased with the use of a PDA for my day to day responsibilities.							
33. Utilizing a PDA will decrease my productivity.							
34. The EHR system will increase our operating costs.							
35. The quality of patient care will increase with the use of computerized tools.							
36. PDA's are confusing to use.							
37. Training will be required in order to effectively use the PDA for patient data capture.							
38. The template that the computerized tool uses for patient data input makes it easy to recognize errors.							
39. If I become skillful with a computerized tool, this will cut down on the time it used to take to complete a task manually.							
40. I believe a PDA is adequate for the display of complex patient data.							
41. When handheld tools are used daily, updating data is critical for private patient data, billing and electronic health records (EHR) updates.							

Adopting an Electronic Health Record in Clinical Healthcare

42. Please answer the following question if you are using a Personal Digital Assistant (handheld). What is the procedure for updating patient data?

Synchronization with main frame computer in Hospital or Clinic	Synchronize with server in medical practice or Internet provider	Synchronize with desktop computer	Synchronize with laptop computer	Synchronize with tablet computer

Please fill in your response

43. Has anything affected your patients' privacy or security in your work environment?

APPENDIX D

RESEARCH CONSTRUCTS

Appendix Sections D.1 to D.3 represent the constructs that were evaluated in the survey instrument for Study II and Study III.

APPENDIX D.1 SURVEY CONSTRUCTS - STUDY II

NJIT
New Jersey's Science & Technology University

The Adoption of Information Technology in Clinical Healthcare Constructs

Demographics (Cover Sheet):

Q1. What is your primary specialty?
Q2. If applicable, what is your sub-specialty?
Q3. Gender: Male Female (Circle One)
Q4. What is your age group? **20-30** **31-40** **41-50** **51-60** **61+** (Circle One)
Q5. Are you a member of? (Check applicable box)
Q6. Number of years experience in the Clinical Healthcare field?
Q7. Number of years experience in the Information Technology (IT) field?
Q8. What is your highest educational background?
Q9. How many years of hands-on experience do you have working with computers?
Q10. How knowledgeable do you consider yourself to be about the following?

Healthcare Providers Demographics (Cover Sheet/Cross Culture Analysis):

Q33. What is the name and location of the medical school you attended?
Q34. What year did you graduate?
Q35. Did your medical school have an information technology curriculum? **Yes** **No**
Q36. If you have had information technology education or training, please indicate.

Questionnaire:

Information Technology (basic computer knowledge, types of computer systems):

Q1. In clinical healthcare, how important is it to have immediate access to information?
Q2. How often do you use a computer information system when completing daily tasks?
Q3. Approximately what percentage of medical records in clinical healthcare comes from a computerized information system?
Q4. In the following setting how often do you use a Personal Digital Assistant (PDA)?
Q5. In a clinical healthcare setting, how often do you use the following?
Q6. In an information technology setting, how often do you use the following?
Q7. If access to another type of information technology equipment occurs in clinical healthcare settings, please explain.
Q8. For clinical healthcare providers who desire fast access to patient information, what size computerized tool would you want?
Q9. For clinical healthcare providers who desire computerized tools for access to information technology, what would be the largest size device you would be willing to carry?

The Adoption of Information Technology in Clinical Healthcare Constructs

Q10. If your current manual system (pen/paper) were converted to a computer information system, how would the change affect the tasks of delivering clinical healthcare services?

Q11. In a computerized clinical healthcare system with checks and balances for dealing with patient prescriptions, ordering tests and reporting correct data would have to be:

Q14. To what degree are current software applications developed and programmed by an in-house information technology department?

Q15. To what degree are current software applications proprietary (i.e., purchased from outside vendors)?

Q16. When developing new computer information systems for clinical healthcare, to what degree have healthcare professionals in your department/organization been consulted?

Q18. Are clinical healthcare systems developed by an in-house information technology department able to be integrated into existing organizational applications?

Q19. Have new applications the ability to be modified and or upgraded when information requirements change?

Security:

Q12. What would be required for you to use a wireless network connection to transmit patient information in clinical healthcare?

Q13. In order to have secure and confidential data for clinical healthcare systems, what would be required for your use?

Q24. Is security is a major factor in determining clinical healthcare information technology requirements for clinical healthcare systems?

Q25. Would a computerized clinical healthcare system produce useful patient data?

Confidentiality, Privacy and Electronic Health Records (EHR):

Q23. Is confidentiality a major factor in determining information technology requirements for clinical healthcare systems?

Q26. Does using a wireless network connection to transmit patient information create privacy risks?

Q27. Is there a need for computerization of patient health records (Electronic Health Records)?

Q28. Is maintaining a secure environment for patient records very important?

Q29. Does maintaining computerized patient (EHR) health records decrease medical errors?

Q30. If proprietary software is purchased, what are the security requirements designated for the vendor when confidential data has to be accessed for development?

Q31. What measures have you undertaken to keep patient health records confidential?

The Adoption of Information Technology in Clinical Healthcare Constructs

Q32. What other issues can you discuss that have impacted your confidentiality/privacy requirements?

Costs:

Q17. Has cost been a significant factor in preventing the adoption of an integrated computerized system for clinical healthcare in your organization?

TAM2/Perceived Usefulness:

Q20. If you are not using information technology for clinical healthcare systems, do you believe adding this technology will increase productivity?

Q21. Would the time it takes to complete daily tasks decrease with the introduction of computerized clinical healthcare systems?

TAM2/Perceived Ease Of Use:

Q22. Would using computerized clinical healthcare systems increase the time it takes to complete daily clinical tasks?

APPENDIX D.2 SURVEY CONSTRUCTS - STUDY III

NJIT
New Jersey's Science & Technology University

Adopting an Electronic Health Record in Clinical Healthcare

Demographics (Cover Sheet):

Q1. What is your primary job description?
Q2. If applicable, do you have a secondary job description?
Q3. Gender: Male Female (Circle One)
Q4. What is your age group? **20-30** **31-40** **41-50** **51-60** **61+** (Circle One)
Q5. Are you a member of? (Check applicable box). Other, explain.
Q6. Number of years experience in the following setting. (Select the one that is applicable for you).
Q7. Please indicate your highest educational achievement.
Q8. How many years of hands-on experience do you have working with computers?
Q9. How knowledgeable do you consider yourself to be about the following?

Healthcare Providers Demographics (Cover Sheet/Cross Culture Analysis):

Q10. What is the name and location of the medical school you attended?
Q11. What year did you graduate?
Q12. Did your medical school have an information technology curriculum? **Yes** **No**
Q13. If you have had information technology education or training please indicate?

Questionnaire:

Information Technology (basic computer knowledge, types of computer systems):

Q1. How often do you use a computer information system when completing daily tasks?
Q2. In your professional setting how often do you use a Personal Digital Assistant (PDA)? (**Circle your applicable frequency**)?
Q3. How often do you use the following? (**Check all that are applicable**).
Q4. If you have access to another type of information technology equipment (other than the above), in a clinical healthcare setting please identify and explain how you use it.
Q5. What would be the largest size device you would be willing to carry?
Q6. In your work environment, to what degree are current software applications developed and programmed by an **in-house** information technology department?
Q7. In your work environment to what degree are current software applications proprietary (i.e., purchased from **outside vendors**)?
Q8. In clinical healthcare, how important is it to have immediate access to information?
Q9. If you were considering an electronic device for accessing patient information, what kind of computerized tool would you prefer? **(Please choose one)**.
Q10. Approximately what percentage of medical records in clinical healthcare comes from an electronic health records (EHR) system?
Q11. Please indicate the type of practice you work in.
Q12. Please indicate the approximate number of medical records in your system.
Q13. When considering an EHR system for your practice or institution, to what degree have the following been consulted?
Q14. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have: (14a -14g).

(Pg. 2)

Adopting an Electronic Health Record in Clinical Healthcare

Information Technology (basic computer knowledge, types of computer systems):

Q17. Clinical healthcare systems developed by an **in-house** information technology department are able to be integrated into existing organizational applications.
Q18. New applications have the ability to be modified and or upgraded when information requirements change.
Q42. Please answer the follow question if you are using a Personal Digital Assistant (handheld). What is the procedure for updating patient data?

*Question #13 can be used as a dual construct (EHR).
*Question #14 can be used as a dual construct (Security and EHR).
*Question #18 is a check point question.

Security:

Q14a. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have the highest security/none.
Q22. Confidentiality is a major factor in determining information technology requirements for electronic health records.
Q23. Security is a major factor in determining information technology requirements for EHR.
Q24. A computerized clinical healthcare system would produce useful patient data.
Q27. Maintaining a secure environment for patient records is very important.

*Question #14 can be used as a dual construct (Security and EHR).

Confidentiality, Privacy and Electronic Health Records (EHR):

Q15. What standards/requirements have you undertaken to keep patients' EHR'S? private?
Q22. Confidentiality is a major factor in determining information technology requirements for electronic health records.
Q25. Using a wireless network connection to transmit patient information creates privacy risks.
Q26. There is a need for computerization of patient health records.
Q27. Maintaining a secure environment for patient records is very important.
Q28. Maintaining computerized patient electronic health records (EHR) decreases medical errors.
Q41. When handheld tools are used daily, updating data is critical for private patient data, billing and electronic health records (EHR) updates.
Q43. Has anything affected your patients' privacy or security in your work environment?

*Question #13 can be used as a dual construct (see IT).
*Question #14 can be used as a dual construct (see IT).
*Question #26 can be used as a dual construct (see TAM2/Perceived Usefulness).
*Question #28 can be used as a dual construct (see TAM2/Perceived Usefulness).
*Question #29 can be used as a dual construct (see EHR).
*Question #41 can be used as a dual construct (see TAM2/Perceived Ease of Use).

(Pg. 3)

Adopting an Electronic Health Record in Clinical Healthcare

Costs:

Q16. Cost has been a significant factor in preventing the adoption of an electronic health record (EHR) system for clinical healthcare in my organization.
Q34. The EHR system will increase our operating costs.

TAM2/Perceived Usefulness:

Q18. New applications have the ability to be modified and or upgraded when information requirements change.
Q19. If I am not using an EHR system, I believe that adding this technology will increase productivity.
Q20. The time it takes to complete daily tasks would decrease with the introduction of computerized electronic health records.
Q24. A computerized clinical healthcare system would produce useful patient data.
Q26. There is a need for computerization of patient health records.
Q28. Maintaining computerized patient (EHR) health records would decrease medical errors?
Q29. A personal digital assistant (PDA) will allow me to complete EHR tasks more efficiently.
Q31. Training in the usage of PDA's will not be required; I will be able to use the tool immediately.
Q32. Productivity will be increased with the use of a PDA for my day to day responsibilities.
Q33. Utilizing a PDA has decreased my productivity.
Q35. The quality of patient care will increase with the use of computerized tools.

*Question #28 can be used as a dual construct (see EHR).
*Question #29 can be used as a dual construct (see EHR).

TAM2/Perceived Ease Of Use:

Q14b; Q14c; Q14e; Q14f & Q14g
Q21. Using computerized clinical healthcare systems will increase the time it takes to complete daily clinical tasks.
Q30. PDA's will have an interface that is easy to use.
Q36. PDA's are confusing to use.
Q37. Training will be required in order to effectively use the PDA for patient data capture.
Q38. The template that a computerized tool uses for patient data input makes it easy to recognize errors.
Q39. If I become more skillful with a computerized tool, this will cut down on the time it used to take to complete a task manually.
Q40. I believe a PDA is adequate for the display of complex patient data.
Q41. When handheld tools are used daily, updating data is critical for patient data, billing and electronic health records (EHR) updates.

*Question # 41 can be used as a dual construct (see EHR).

APPENDIX D.3 WOSP SURVEY CONSTRUCTS - STUDY III

NJIT
New Jersey's Science & Technology University

Adopting an Electronic Health Record in Clinical Healthcare
Web of System Performance Constructs

WOSP perception constructs (see figure 11) that are being tested are listed below with the appropriate variables that have been analyzed utilizing the Mann-Whitney U Test in SPSS for statistical significance.

Usability Constructs:

Q8. In clinical healthcare, how important is it to have immediate access to information?

Q14b. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have friendliness/Unfriendliness.

Q14c. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have ease of use/difficulty of use.

Q14e. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have private access/public access.

Q14f. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have usefulness/no usefulness.

Q14g. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have compatibility/non-compatibility.

Security Constructs:

Q14a. An EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have the highest security/none.

(Pg. 2)

Adopting an Electronic Health Record in Clinical Healthcare
Web of System Performance Constructs

Q22. Confidentiality is a major factor in determining information technology requirements for electronic health records.

Q23. Security is a major factor in determining information technology requirements for EHR.

Q27. Maintaining a secure environment for patient records is very important.

Functionality/Reliability Constructs:

Q18. New applications have the ability to be modified and or upgraded when information requirements change.

Q20. The time it takes to complete daily tasks will decrease with the introduction of computerized electronic health records.

Q24. A computerized clinical healthcare system will produce useful patient data.

Q26. There is a need for computerization of patient health records.

Q28. Maintaining computerized patient electronic health records (EHR) decreases medical errors.

Q35. The quality of patient care will increase with the use of computerized tools.

IT Adoption Constructs:

Q18. New applications have the ability to be modified and or upgraded when information requirements change.

Q20. The time it takes to complete daily tasks will decrease with the introduction of computerized electronic health records.

Q24. A computerized clinical healthcare system will produce useful patient data.

Q26. There is a need for computerization of patient health records.

Q28. Maintaining computerized patient electronic health records (EHR) decreases medical errors

Adopting an Electronic Health Record in Clinical Healthcare
Web of System Performance Constructs

Q29. A personal digital assistant (PDA) will let me complete EHR tasks more efficiently.

Q30. PDA's will have an interface that is easy to use.

Q31. Training in the usage of PDA's will not be required; I will be able to use the tool immediately.

Q32. Productivity will be increased with the use of a PDA for my day to day responsibilities.

Q35. The quality of patient care will increase with the use of computerized tools.

Q39. If I become skillful with a computerized tool, this will cut down on the time it used to take to complete a task manually.

Q40. I believe a PDA is adequate for the display of complex patient data.

APPENDIX E

PARTICIPANTS INCENTIVES

Appendix Sections E.1 to E.4 are incentives that were offered for participation in Study III.

APPENDIX E.1 PHYSICIAN INCENTIVE - STUDY III

THE NATIONAL CHILDREN'S CANCER SOCIETY

The mission of **The National Children's Cancer Society** is to improve the quality of life for children with cancer by promoting children's health through financial and in-kind assistance, advocacy, support services, and education.

1015 Locust Suite 600 • St. Louis, MO 63101 • Phone: 314.241.1600 • Fax: 314.241.1996 •
www.nationalchildrenscancersociety.org

In appreciation for your thoughtful participation in our academic research endeavor, we would like to make a donation in your honor to **The *National Children's Cancer Society.***

Simply fill out this form with your name and contact information and **MAIL** or **Fax** it along with your *signed* "Consent To Participate" form to:

NJIT
New Jersey's Science & Technology University

Dr. Fadi P. Deek
New Jersey Institute of Technology
College of Science and Liberal Arts
323 Martin Luther King Blvd.
University Heights
Newark, NJ 07102-1982
Fax: (973) 565-0586

This donation can only be made when the ***completed survey*** and these forms are returned no later than May 30, 2007.

THANK YOU FOR COMPLETING THIS SURVEY

Name: ______________________________

Address: ______________________________

Phone: ______________ Email: ______________

APPENDIX E.2 IT AND HEALTHCARE INCENTIVE - STUDY III

ENTRY FORM: Enter to a ***Memorex 512, 1GB or 2GB USB travel drive***! Complete this entry form or attach a business card.

Simply fill out this form with your name and contact information and **MAIL** or **Fax** it along with your *signed* "Consent To Participate" form to:

NJIT
New Jersey's Science & Technology University

Dr. Fadi P. Deek
New Jersey Institute of Technology
College of Science and Liberal Arts
323 Martin Luther King Blvd.
University Heights
Newark, NJ 07102-1982
Fax: (973) 565-0586

You can only be entered in the drawing when the ***completed survey*** and these forms are returned no later than May 30, 2007.

THANK YOU FOR COMPLETING THIS SURVEY

Name: ______________________________

Address: ______________________________

Phone: ______________ Email: ______________

APPENDIX E.3 PHYSICIAN THANK YOU CARD - STUDY III

THE NATIONAL CHILDREN'S CANCER SOCIETY

The N.C.C.S. provides help and hope
through direct financial assistance, emotional support and
educational resources to children with cancer
and their families.

www.nationalchildrenscancersociety.org
1-800-5-FAMILY

APPENDIX E.4 NOTATION IN CARD FOR PHYSICIANS - STUDY III

This inscription appears as the note of thanks (inside Appendix E.3) and was mailed to all Physicians who participated in the study.

In appreciation for your thoughtful participation in this academic research endeavor, Karen Hare (New Jersey Institute Of Technology) has made a donation in your name to The National Children's Cancer Society. Without your assistance this research would not have been possible.

Because of this donation, children with cancer and their families will be able to find the financial and emotional support they need.

APPENDIX F

DESCRIPTVE STATISTICS – STUDY I - III

Appendixes F.1.1 to F.3.5 represent descriptive statistics that span chronologically from Study I through Study III.

APPENDIX F.1 PILOT STUDY I

PRE-PILOT STUDIES I AND II RESEARCH METHODOLOGY

Research Question: How Is Information Technology Change Managed, While Optimizing The Way Information Is Utilized By People And Organizations, Based On Diffusion Of Innovation Approaches?

Objectives: This study was conducted to determine the level of acceptance, resistance and change associated with the introduction of information technology into operating departments in health care organizations. In addition, it is necessary to identify the kinds of structural problems that may develop in the transition and, particularly, the ways these problems are defined and managed.

Methods: The study used questionnaires for the initial analysis for the Preliminary Pilot Study. Questionnaires, Focus Groups (audio taping) and Observations will be used in the pursuit of information gathering for subsequent studies. All participants in the study have or will sign Consent Forms (Appendix B) prior to completing the Questionnaire (Appendix C.1).

The tools associated with this research are as follows:

Questionnaires – respondents are anonymous. The questionnaire does not have names or other identifying information.

Consent Form – participation is voluntary and participants can refuse to participate, or may discontinue participating at any time, without penalty, without coercion.

Observation – participants will be observed as they conduct their day-to-day tasks while using the information technology (IT) systems.

Sample: UMDNJ employees comprise the sample population for data collection. The participants were of working age who voluntarily agreed to participate in the audio taped focus groups and or complete the questionnaire. No minors will be used for the study. There were 14 focus group interviews conducted with the various departmental Administrators, Program Directors and Managers to set up the first Pilot Study (I) and the subsequent Full blown study. Each person interview was given an Entrée Letter (Appendix A.1) identifying the research and Principal Investigator gave an overview of the research. The Entrée Letter was adapted from Schatzman and Strauss (1973, pp. 25-26).

Analysis: This is a triangulated study using both qualitative and quantitative analysis. Qualitatively, constant comparative analysis as described by Glaser and Strauss (1999), will be used to formulate categories of response concerning work with Information Technology. Quantitatively, demographic data was compiled as descriptive statistics and Likert Scales were evaluated with SPSS as the statistical software package.

F.1.1 PILOT STUDY I RESULTS

Pilot Study I was conducted in the fall of 2003 with 18 participants from Ob/Gyn Associates in the Doctors Office Center. Several systems are used within Ambulatory Care Services at UMDNJ. There were four major systems used out of the five by this department for the pilot. Users can access more than one of these following Hospital Information Management Systems (HIMS), (See Figure 3):

Epic – Outpatient system that has clinical and some demographic information. Future plans include eventually using this system to replace Healthquest and integrate other components into this system (i.e., scheduling, billing capability).

Healthquest – Registration system for clinic patients. Healthquest interfaces with infinity to download registration information. This is a one-time transfer; patient information changes have to be corrected manually.

Infinity – Billing and Scheduling System. Currently used in Ob/Gyn faculty practice and ophthalmology. Ob/Gyn's scheduling is done thru Infinity once system registration is downloaded from the Healthquest System. Additionally, United Physician Associations (UPA)/ DOC practice physician charge tickets are also printed for services rendered. The Infinity system does not print or generate any hospital bills; outpatient services are for Ob/Gyn DOC only.

Logician – Computerized Electronic Patient Medical Record system that is used on an outpatient basis only. Logician does have a scheduling component, but it is not being utilized by the hospital. Clinical information for a patient's visit, medication prescribed, test ordered and treatment are documented.

PAS System – Patient Appointment Scheduling System; strictly a scheduling system. Everything here ties to a patients' appointment for the 51 University Hospital clinics that use this system. Nothing regarding clinical information is contained in this system.

F.1.2 FUTURE DIRECTION TAKEN

The qualitative aspect of the responses from the questionnaires allowed me to glean a beginning insight into the diffusion of technological innovations that have been introduced at UMDNJ. Based on the finding from Pilot I's questionnaire, the following results were identified. The pilot results did not include any focus group data.

However, the data from the participants in the focus group interviews were collected and used to construct new questions and address outstanding research issues not addressed in the first study. This exploratory research analyzed all data collected with SPSS as the statistical software tool. All results have been used for the subsequent studies (Pilot Study II and the final Study III, Appendix F.2 through Appendix F.3.3).

The number of years that each participant (Human Factor) has interacted with computerized information technology varied (which is illustrated in Appendix F.1.4). Most of the participants in Pilot Study (I) utilized the system between a half-day to a full day; many indicated that the system was antiquated with missing or non-existent features. Users thought the system was not user friendly; some users had no email and Internet access even if they were using one of the hospital information systems. In the case of email, it is not given to employees as a university-wide technology; Intranet access for specific departmental requirements is used (called "Flags"). Flags are comprised of an internal email system that patient representatives use to alert physicians and medical staff on specific patient-related follow-up.

The Nurses in DOC Ob/Gyn Associates stressed that there was a major need to have a computerized list of instruments that is standardized for clinics. Currently they have a manual system that entails a hand-written list that indicates when instruments are checked in or out of the hospital for clinic procedures.

F.1.3 DESCRIPTIVE ANALYSIS PILOT STUDY I

Descriptive analysis was conducted with the results from the questionnaires, which were further analyzed using SPSS (see Appendix F.1.4 – F.1.5). The results of the descriptive analysis emphasized several categories of participant responses from a select group of questions. The instrument was comprised of 17 questions; the first eight questions capture demographic data and the next 8 are Likert scales; the last question solicits information technology. Referring to question 17 on the questionnaire, the SPSS results are indicative of these three categories:

- Functionality
- User-friendly and system integration
- Faster response time

F.1.4 PILOT STUDY I - COMPUTER USAGE BY OB/GYN CLINIC

The following tables in this appendix represent the results from the first study.

Years of Computer Experience

Years of Computer Experience	Number	Percent	Cumulative Percent
1 – 5 Years	7	38.9	41.2
6 – 10 years	6	33.3	76.5
11 – 15 years	3	16.7	94.1
15 or more years	1	5.6	100.0
Total Respondents	17	94.4	
Missing	1	5.6	
Total	18	100.0	

Analysis: Distribution of reported years of computer experience in the Ob|Gyn Associates Clinic. Overall, 38.9 % of the sample has between 1 – 5 years computer experience; 33% of the sample has between 6 – 10 years; 16.7% have 11- 15 years and 5.6% indicated that they had over 15 years of computer experience.

F.1.5 PILOT STUDY I - SPSS RESULTS

The following tables in this section represent the SPSS results from each question in the first study.

Q. 1. Department

Q. 1. Department		N	Percent	Cumulative Percent
Valid	Amb. Care Svcs.	1	5.6	5.6
	Ob/Gyn	16	88.9	94.4
	Out Pt.	1	5.6	100.0
	Total	18	100.0	

Q. 2a. Logician

Q. 2a. Logician		N	Percent	Cumulative Percent
Valid	Yes	17	94.4	94.4
	No	1	5.6	100.0
	Total	18	100.0	

Q. 2b. Epic

Q. 2b. Epic		N	Percent	Cumulative Percent
Valid	Yes	1	5.6	5.6
	No	17	94.4	100.0
	Total	18	100.0	

Q. 2c. Handheld

Q. 2c. Handheld		N	Percent	Cumulative Percent
Valid	Yes	1	5.6	5.6
	No	17	94.4	100.0
	Total	18	100.0	

Q. 2d. Healthquest

Q. 2d. Healthquest		N	Percent	Cumulative Percent
Valid	Yes	3	16.7	16.7
	No	15	83.3	100.0
	Total	18	100.0	

Q. 2e. Infinity

Q. 2e. Infinity		N	Percent	Cumulative Percent
Valid	Yes	1	5.6	5.6
	No	17	94.4	100.0
	Total	18	100.0	

Q. 3. Respondent Gender

Q. 3. Respondent Gender		N	Percent	Cumulative Percent
Valid	Female	17	94.4	94.4
	Male	1	5.6	100.0
	Total	18	100.0	

Q. 4. Years at UMDNJ

Q. 4. Years at UMDNJ		N	Percent	Cumulative Percent
Valid	Less than 1 year	1	5.6	5.6
	1-5 years	4	22.2	27.8
	6-10 years	2	11.1	38.9
	11-15 years	5	27.8	66.7
	15 or more years	6	33.3	100.0
	Total	18	100.0	

Analysis: More than 60% of the sample has been employed at UMDNJ over 10 years (experience level).

Q. 5. Job Position

Q. 5. Job Position		N	Percent	Cumulative Percent
Valid	Management	1	5.6	5.9
	Administration	2	11.1	17.6
	Nursing Staff	10	55.6	76.5
	Support Staff	4	22.2	100.0
	Total	17	94.4	
Missing	System	1	5.6	
Total		18	100.0	

Analysis: Nurses comprise more than 50% of the staffing component, and Support Staff makes up more than 20%

Q. 6. Years of Computer Experience

Q. 6. Years of Computer Experience		N	Percent	Cumulative Percent
Valid	1-5 years	7	38.9	41.2
	6-10 years	6	33.3	76.5
	11-15 years	3	16.7	94.1
	15 or more years	1	5.6	100.0
	Total	17	94.4	
Missing	System	1	5.6	
Total		18	100.0	

Q. 7. Educational Background

Q. 7. Educational Background		N	Percent	Cumulative Percent
Valid	High School	1	5.6	5.6
	Some College	8	44.4	50.0
	College Degree	4	22.2	72.2
	Masters Degree	4	22.2	94.4
	M.D.	1	5.6	100.0
	Total	18	100.0	

Q. 8. Frequency of computer system use

Q. 8. Frequency of computer system use		N	Percent	Cumulative Percent
Valid	Most of the day	7	38.9	38.9
	The entire day	11	61.1	100.0
	Total	18	100.0	

Analysis: 61% of the sample uses their computer all day, while 39% are using the computer most of the day.

Q. 9a. CIS Simplicity/Complexity Evaulation

Q. 9a. CIS Simplicity/Complexit		N	Percent	Cumulative Percent
Valid	1	4	22.2	22.2
	2	5	27.8	50.0
	3	2	11.1	61.1
	4	5	27.8	88.9
	5	1	5.6	94.4
	7	1	5.6	100.0
	Total	18	100.0	

Analysis: 61% of the sample reports that the system is easy to use, while 28% are neutral and 11% who are more likely to evaluate the system as being more complex.

Q. 9b. CIS Friendliness/Unfriendliness Evaluation

Q. 9b. CIS Friendliness/Unfriendlines		N	Percent	Cumulative Percent
Valid	1	3	16.7	16.7
	2	4	22.2	38.9
	3	6	33.3	72.2
	4	3	16.7	88.9
	6	1	5.6	94.4
	7	1	5.6	100.0
	Total	18	100.0	

Analysis: 72% of the sample believes the system is user friendly, whereas, 17% of the sample felt neutral about this category and 11% are more likely to view the system as unfriendly.

Q. 9c. CIS Easiness/Difficulty Evaluation

Q. 9c. CIS Easiness/Difficulty		N	Percent	Cumulative Percent
Valid	1	6	33.3	33.3
	2	5	27.8	61.1
	3	1	5.6	66.7
	4	3	16.7	83.3
	5	1	5.6	88.9
	6	1	5.6	94.4
	7	1	5.6	100.0
	Total	18	100.0	

Analysis: 67% of the sample thought the system was easy to use; 16% neutral and 17% felt it was difficult to use.
Analysis 9D: 28% of the sample felt that the system was a hindrance, 28% was neutral and 44% found the system helpful.

Q. 9d. CIS Hindrance/Helpfulness Evaluation

Q. 9d. CIS Hindrance/Helpfulness		N	Percent	Cumulative Percent
Valid	1	2	11.1	11.1
	2	2	11.1	22.2
	3	1	5.6	27.8
	4	5	27.8	55.6
	6	4	22.2	77.8
	7	4	22.2	100.0
	Total	18	100.0	

Q. 9e. CIS Threat Evaluation

Q. 9e. CIS Threat		N	Percent	Cumulative Percent
Valid	1	1	5.6	5.6
	2	6	33.3	38.9
	3	1	5.6	44.4
	4	3	16.7	61.1
	6	3	16.7	77.8
	7	4	22.2	100.0
	Total	18	100.0	

Analysis 9E: 44% were intimidated by the system, 17% were neutral and 39% were not intimidated by the system.

Q. 10. Needed Feature

Q. 10. Needed Featur		N	Percent	Cumulative Percent
Valid	Strongly Agree	2	11.1	11.1
	Agree	9	50.0	61.1
	Neutral	5	27.8	88.9
	Disagree	2	11.1	100.0
	Total	18	100.0	

Q. 11. Easy to Understand Screen Layout

Q. 11. Easy to Understand Screen Layout		N	Percent	Cumulative Percent
Valid	Strongly Agree	5	27.8	27.8
	Agree	10	55.6	83.3
	Neutral	1	5.6	88.9
	Disagree	1	5.6	94.4
	Strongly Disagree	1	5.6	100.0
	Total	18	100.0	

Q. 12. Clear and Easy to Follow System Design

Q. 12. Clear and Easy to Follow System Design		N	Percent	Cumulative Percent
Valid	Strongly Agree	2	11.1	11.1
	Agree	11	61.1	72.2
	Neutral	2	11.1	83.3
	Disagree	1	5.6	88.9
	Strongly Disagree	2	11.1	100.0
	Total	18	100.0	

Q. 13. Understood Terminology

Q. 13. Understood Terminology		N	Percent	Cumulative Percent
Valid	Strongly Agree	4	22.2	22.2
	Agree	12	66.7	88.9
	Neutral	2	11.1	100.0
	Total	18	100.0	

Q. 14. Logical Data Entry Process

Q. 14. Logical Data Entry Process		N	Percent	Cumulative Percent
Valid	Agree	13	72.2	72.2
	Neutral	3	16.7	88.9
	Strongly Disagree	2	11.1	100.0
	Total	18	100.0	

Q. 15. Paper and Pencil Preferred

Q. 15. Paper and Pencil Preferred		N	Percent	Cumulative Percent
Valid	Agree	1	5.6	5.6
	Neutral	4	22.2	27.8
	Disagree	7	38.9	66.7
	Strongly Disagree	6	33.3	100.0
	Total	18	100.0	

Q. 16. Would Recommend System to Friends

Q. 16. Would Recommend System to Friends		N	Percent	Cumulative Percent
Valid	Agree	8	44.4	44.4
	Neutral	5	27.8	72.2
	Disagree	3	16.7	88.9
	Strongly Disagree	2	11.1	100.0
	Total	18	100.0	

Q. 17. Recommended Changes to System

Q. 17. Recommended Changes to System		N	Percent	Cumulative Percent
Valid	Missing	7	38.9	38.9
	Add more functionality	3	16.7	55.6
	Faster response time	3	16.7	72.2
	Nothing substantial	2	11.1	83.3
	User friendly/Integrated	3	16.7	100.0
	Total	18	100.0	

Analysis:

1. **Functionality** was a primary concern (17%). The answers ranged from pop-up notifications to keeping ones password for system access. Request for statistical information based on patient test/procedure results.

2. **User-friendly/integration** (17%). Request for a system that was multifunctional, capable of handling registration, billing, scheduling. Antiquated was another phrase with request to update the system and make larger screens and give all employees Internet access. Being able to print and synchronize data between handheld computers and the current systems. There was a defiant need for more integrated systems. Not all Human Factors (participants) are using Information Technology to its fullest extent. It is apparent the IT requirements are changing and the ones that have access are embracing the technology, and those don't have the technology are not aware of what they are missing.

3. **Faster response time** (17%). Participant indicated their impatience with the amount of time it takes to log onto the system.

An ANOVA is listed below with the years employed by UMDNJ and years of computer experience.

Evaluation of Hospital Clinical Information Systems
ANOVAS (Total N = 18)

Years At UMDNJ	< 1 Year (N=1)	1- 5 Years (N=4)	6 – 10 Years (N=2)	11 – 15 Years (N=5)	15 Plus Years (N=6)	P (*) Significance
Simplicity/ Complexity	7.00	4.25	2.00	2.60	1.83	*.001
Friendliness/ Unfriendliness	7.00	4.00	2.00	2.80	2.17	*.013
Easiness/ Difficulty	7.00	4.25	2.00	1.60	2.17	*.010
Hindrance/ Helpfulness	1.00	3.00	4.00	5.20	5.67	NS
Threatening/ Unthreatening	2.00	4.00	4.50	3.40	5.00	NS

Figure F.16 ANOVA.

APPENDIX F.2 STUDY II – 10 PARTICIPANTS

STUDY II - RESEARCH QUESTION

Why Is The Adoption of Information Technology Lower in Clinical Healthcare Than Other Healthcare Milieus?

Structured Interviews:

Two structured interviews were conducted with stakeholders responsible for Information Technology acquisitions in their respective facilities. This pilot pre-test of Survey II (see Appendices –3C – 3D) was conducted December 21 - 27, 2005 with a chief information technology officer and a pediatrician, both of whom work in New Jersey. The survey was conducted to test a theory that attempts to explain the perception between Information Technology developers and the technology required by clinical healthcare providers to do their daily tasks. The interviews were done to evaluate these stakeholders' attitudes regarding the adoption of Information Technology, electronic health records (EHR), and mobile applications within their work environment.

Eight additional surveys were conducted after analyzing the data and responses from these two primary stakeholders. The transcripts from Study two's structured interviews assisted with restructuring the questionnaire for the third study (Appendices 3E - 3F, 4B). Additionally, the final instrument was tested at a physician practice to evaluate how clinical providers would respond.

Objectives: To determine the perception gap between Clinical Healthcare Providers and Practitioners and the Information Technology Department; as to the utility of

Healthcare Information Technology Applications that are implemented and adopted within healthcare organizations.

Methods: The study utilized questionnaires for the initial analysis for the Preliminary Pilot Study II. Questionnaires, Focus Groups and Observations will be used in the pursuit of information gathering for this and the subsequent final study. All participants in the study have or will sign Consent Forms (Appendix 2B – 2C) prior to completing the Questionnaire (Appendix 3B – 3D).

The tools associated with this research are as follows:

The questionnaire does not have names or other identifying information.

1. **Questionnaires** – respondents are anonymous. The questionnaire does not have names or other identifying information.
2. **Consent Form** – participation is voluntary and participants can refuse to participate, or may discontinue participating at any time, without coercion
3. **Observation –** participating will be observed as they conduct their day-to-day tasks while utilizing the Information Technology (IT) Systems.

Sample: A combination of Clinical Healthcare providers and Information Technology professionals comprise the sample population for data collection. The participants are of working age that voluntarily agree to participant in an interview and or complete the **Questionnaire**. No minors were used for the study. The following took part in focus group interviews, VP of Nursing, Director of Clinical IT, Director of IT and Physician for Pre-Pilot II. Each person interview was given an Entrée Letter (Appendix 4) identifying the research and Principal Investigator gave an overview of the research. The Entrée Letter was adapted from Schatzman and Strauss (1973, pp. 25-26).

Analysis: This is a triangulated study using both qualitative and quantitative analysis. Qualitatively, constant comparative analysis as described by Glaser and Strauss (1999), will be used to formulate categories of response concerning work with Information Technology. Quantitatively, demographic data was compiled as descriptive statistics and Likert Scales were evaluated with SPSS as the statistical software package.

F.2.1 PILOT STUDY II RESULTS

Pilot II was conducted between December 2005 and May 2006 with 10 participants from a public and private hospital, private medical practice, individual physicians, nurses, information technology, clinical information technology, and support staff personnel. Clinical IT systems varied based on the participants work domain.

F.2.2 PILOT STUDY II – CROSS TABULATIONS

How Knowledgeable are you about Information Technology

Environment	Novice	Slightly	Moderate	Very	Expert
Information Technology					
Clinical Healthcare					
Healthcare Industry					

			Discipline			
			Clinical Healthcare Provider	Information Technology	Healthcare Information Technology	Total
How Knowledgeable of Information Technology	Novice	Count				2
		% within Discipline	28.6%			
	Slightly	Count	4			4
		% within Discipline	57.1%			40.0%
	Moderate	Count	1		1	2
		% within Discipline	14.3%		50.0%	20.0%
	Very	Count			1	1
		% within Discipline			50.0%	10.0%
	Expert	Count		1		1
		% within Discipline		100.0%		10.0%
Total		Count	7	1	2	10
		% within Discipline	100.0%	100.0%	100.0%	100.0%

- All Clinical healthcare /providers report that they have novice to moderate knowledge of Information technology.
- Information technology professionals perceived that they have expert knowledge of IT.

Question 4 - How often do you use a PDA

Not At All	Once A Week	Every 2-3 Days	Once A Day	Every Hour	Most of The Day	Entire Day

Crosstab

			Discipline			
			Clinical Healthcare Provider	Information Technology	Healthcare Information Technology	Total
How often use PDA	Not At All	Count	6		1	7
		% within Discipline	85.7%		50.0%	70.0%
	Every Hour	Count			1	1
		% within Discipline			50.0%	10.0%
	Most of The Day	Count	1			1
		% within Discipline	14.3%			10.0%
	Entire Day	Count		1		1
		% within Discipline		100.0%		10.0%
Total		Count	7	1	2	10
		% within Discipline	100.0%	100.0%	100.0%	100.0%

- 85.7% of Clinical healthcare /providers report they are not using a PDA at all.

Question 5 - How often do you use a Mobile Cart

Crosstab

			Discipline			
			Clinical Healthcare Provider	Information Technology	Healthcare Information Technology	Total
How often use Mobile Cart	Not At All	Count	7	1		8
		% within Discipline	100.0%	100.0%		88.9%
	Most of The Day	Count			1	1
		% within Discipline			100.0%	11.1%
Total		Count	7	1	1	9
		% within Discipline	100.0%	100.0%	100.0%	100.0%

- 88.9 % of Clinical healthcare providers report that they are not using a Mobile cart, while one person or 11.1 % of the healthcare information technology staff reports using a mobile cart most of the day

Question 10C - Changing From a Manual to Computer-Based System Ease of Use

Crosstab

			Discipline			
			Clinical Healthcare Provider	Information Technology	Healthcare Information Technology	Total
Changing Manual to Computer-Based - Ease of Use	Easy to Use	Count	1			1
		% within Discipline	14.3%			10.0%
	2	Count	1			1
		% within Discipline	14.3%			10.0%
	3	Count	2			2
		% within Discipline	28.6%			20.0%
	4	Count	3			3
		% within Discipline	42.9%			30.0%
	5	Count			2	2
		% within Discipline			100.0%	20.0%
	6	Count		1		1
		% within Discipline		100.0%		10.0%
Total		Count	7	1	2	10
		% within Discipline	100.0%	100.0%	100.0%	100.0%

- On a scale of 7 (easy) to 1 (difficult) 57.2 % of clinical healthcare /providers report that changing from a manual to computer-based system as easy to moderately easy to use with clinical tasks.

- 42.9 % of clinical healthcare /providers report that changing to computer-based system as in between easy and difficult.

APPENDIX F.3 STUDY III

EXPLANATION OF SPSS VARIABLES

This section will discuss how the questionnaire (Appendices 3E – 3G) was analyzed using SPSS statistical software for Study III data. SPSS was utilized to test the assumption of normality,

T-Tests, Mann-Whitney U Tests, Cross Tabulation and descriptive statistics for the final study (sections 4.2 - 4.3).

The survey consists of two parts, a cover sheet and the questionnaire. There is a series of 13 demographic questions on the cover sheet that captured information about the participant. This form was coded with an underscored'd' at the end of each question (for example, q1a_d). The first page of the survey makes distinctions among the 4 groups of participants and establishes the classification of the participant for empirical data analysis. Listed below are the cover sheet questions and the applicable variables:

F.3.1 PART ONE - COVER SHEET:

Q1a_d: Numeric characters using the scale values of 1 through 4, which identify one of the four major groups of professionals taking part in the study. The values represent the following domains:

1- Clinical Healthcare Providers (Physicians)
2- Information Technology Professionals
3- Healthcare Information Technology Providers
4- Other Clinical Healthcare Providers

Q1b_d: String, 50 characters, contains the primary job title of the respondent.

Q2_d: String, 50 characters, contains the secondary job title of the respondent.

Q3_d: Numeric character which identifies the gender of the respondent:

1- Male
2- Female

Q4_d: Numeric characters using the scale values of 1 through 5, which identify the age grouping for the respondent. The values represent the following:

1- 20-30 years
2- 31-40 years
3- 41-50 years
4- 51-60 years
5- 61 plus years

Q5a_d: Numeric characters using the scale values of 1 through 7, which identify the specific domain the respondent works in. The values represent the following areas:

1- Medical Staff
2- Administration/Management
3- Clinical Information Systems (CIS)
4- Management Information Systems (MIS)
5- Information Technology (IT)
6- Nursing
7- Support Staff

Q5b_d: String of 50 characters that allows the respondent to indicate any other department that was not listed in "Q5a_d."

Q6a_d: Numeric characters which use the scale values of 1 through 6, which indicate the number of years the respondent has worked in the clinical healthcare field. The values represent the following:

1- Less than 1 year
2- 1-3 years
3- 4-5 years
4- 6-10 years
5- 11-15 years
6- 15 plus years

Q6b_d: Numeric characters which use the scale values of 1 through 6, which indicate the number of years the respondent has worked in the information technology field. The values represent the following:

1- Less than 1 year
2- 1-3 years
3- 4-5 years
4- 6-10 years
5- 11-15 years
6- 15 plus years

Q7_d: Numeric characters which use the scale values of 1 through 7, which indicate the highest educational level the respondent has achieved. The values represent the following:

1- High School
2- Some College
3- College Degree
4- Master's Degree
5- Physician
6- Doctoral Degree
7- Medical Student

Q8_d: Numeric characters which use the scale values of 1 through 7. Indicates the number of years (hand-on) experience the respondent has work with computers. The scales represent the following:

1- None
2- Less than 1 year
3- 1-3 years
4- 4-5 years
5- 6-10 years
6- 11-15 years
7- 15 plus years

Q9a_d: Numeric characters which use the scale values of 1 through 5, which identify how knowledgeable the respondents perceive they are about the information technology environment. The numbers represent the following:

1- Novice
2- Slightly
3- Moderate
4- Very
5- Expert

Q9b_d: Numeric characters which use the scale values of 1 through 5, which identify how knowledgeable the respondents perceive they are about the clinical healthcare environment. The numbers represent the following:

1- Novice
2- Slightly
3- Moderate
4- Very
5- Expert

Q9c_d: Numeric characters which use the scale values of 1 through 5, which identify how knowledgeable the respondents perceive they are about the healthcare industry. The numbers represent the following:

1- Novice
2- Slightly
3- Moderate
4- Very
5- Expert

Questions 10-13 were to be answered by Physicians only:

Q10_d: String of 100 characters that indicate the medical school that the respondent attended (or is currently attending) and its geographical location.

Q11_d: Numeric characters that indicate the year the respondent graduated from medical school (or the expected graduation date).

Q12_d: Numeric characters that indicate if there was an information technology curriculum in place at the respondent's medical school. The numbers represent the following:

1- Yes
2- No

Q13_d: String of 100 characters that indicates whether the respondent has had any information technology education or training.

F.3.3 PART TWO – QUESTIONNAIRE:

The second part of the survey is the questionnaire which consists of a series of 43 questions that captured information about the participants' perceptions of their information technology requirements. This form was coded with a "Q" followed by the question number (for example, Q1 thru Q43). Listed below are the questions that appear on the survey and the applicable variables.

Q1: Numeric characters which use the scale values of 1 through 7, which indicate the amount of time a respondent uses a computer for daily tasks. The numbers represent the following:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q2: Numeric character which use the scale value of 1 thru 7, which indicate whether a respondent uses a Personal Digital Assistant (PDA) for daily tasks. The numbers represent the following:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q3: Numeric characters which use the scale values of 1 through 7, which indicate how often the respondent use the following six types of information technology tools (Q3a thru Q3f):

Q3a: Handheld (PDA):

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q3b: Tablet Computer:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q3c: Laptop Computer:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q3d: Desktop Computer:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q3e: Mobile Cart:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q3f: Other:

1- Not at all
2- Once a week
3- Every 2-3 days
4- Once a day
5- Every hour
6- Most of the day
7- Entire day

Q4: String of 100 characters which indicates respondents' statements about whether they have access to any other IT or mobile tool that was not listed in Q3.

Q5: Numeric characters which use the scale values of 1 through 4, which indicate the largest size information technology tools a respondent is willing to carry. The scales represent the following IT tools:

1- Cell phone
2- Handheld (PDA)
3- Tablet computer
4- Laptop computer

Q6: Numeric character which use the scale value of 1 through 7, which indicate to what degree software applications are developed and programmed by in-house IT departments at the respondents work environment. The numbers represent the following:

1- None
2- 0-19%
3- 20-39%
4- 40-59%
5- 60-79%
6- 80-90%
7- 100%

Q7: Numeric character which use the scale value of 1 through 7, which indicate to what degree software applications are proprietary at the respondents work environment. The numbers represent the following:

1- None
2- 0-19%
3- 20-39%
4- 40-59%
5- 60-79%
6- 80-90%
7- 100%

Q8: Numeric characters which use the scale values of 1 through 5, which indicate how important it is for the respondent to have immediate access to information in clinical healthcare. The scales represent the following:

1- Not Significant
2- Neutral
3- Slightly Significant
4- Significant
5- Very Significant

Q9: Numeric characters which use the scale values of 1 through 5, which indicate the largest size information technology tools a respondent is willing to carry. The scales represent the following IT tool

1- Handheld (PDA)
2- Tablet computer
3- Laptop computer
4- Desktop PC
5- Mobile Cart

Q10: Numeric character which use the scale value of 1 through 7, which indicate the percentage of medical records in the respondent practice that come from an EHR system. The numbers represent the following:

1- None
2- 0-19%
3- 20-39%
4- 40-59%
5- 60-79%
6- 80-90%
7- 100%

Q11: Numeric characters which use the scale values of 1 through 5, which indicate the type of practice a respondent works in. The scales represent the following:

1- Solo Practice
2- Group Practice
3- Clinic
4- Hospital
5- Hospital Chain

Q12: Numeric character which use the scale value of 1 through 4, which indicate the approximate number of medical records in the respondents system. The numbers represent the following:

1- 1-999
2- 1,000-9,999
3- 10,000-99,999
4- Greater than 100,000

Q13: Numeric character which use the scale value of 1 through 4, which indicate when considering an EHR system for your practice or institute, to what degree have the following been consulted. The numbers represent the following:

Q13a. Administration/Management
1- Not Consulted
2- Partially Consulted
3- Partially Consulted
4- Fully Consulted

Q13b. Clinical Records Department
1- Not Consulted
2- Partially Consulted
3- Partially Consulted
4- Fully Consulted

Q13c. Departmental/Supervisory
1- Not Consulted
2- Partially Consulted
3- Partially Consulted
4- Fully Consulted

Q13d. Users
1- Not Consulted
2- Partially Consulted
3- Partially Consulted
4- Fully Consulted

Q14: Numeric characters which use the scale values of 1 through 7, which indicate what the respondent perceives an EHR system with an audit trail for dealing with patient follow-up, prescriptions, ordering tests and reporting results will have to have. The numbers represent the value for the following Likert scale for Q14a thru Q14g:

Q14a. Highest Security/None

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q14b. Friendliness/Unfriendliness

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q14c. Ease of Use/Difficulty of Use

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q14d. Private Access (Intranet)/Public Access (Internet)

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q14e. Usefulness/No Usefulness

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q14f. Compatibility/Non-Compatibility

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q14g. Reliability/Unreliability

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q15: String of 200 characters that indicates whether the respondent organization has standards/requirements established to keep patient's EHR private.

Q16: Numeric characters which use the scale value of 1 through 7, which indicate cost has been a significant factor in preventing the adoption of an electronic health record (EHR) system for clinical healthcare in my organization. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q17: Numeric character which uses the scale value of 1 through 7, which indicate clinical healthcare systems developed by an **in-house** Information Technology department are able to be integrated into existing organizational applications. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q18: Numeric character which uses the scale value of 1 through 7, which indicate new applications have the ability to be modified and or upgraded when information requirements change. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q19: Numeric character which uses the scale value of 1 through 7, which indicate if I am not using an EHR system, I believe that adding this technology will increase productivity. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q20: Numeric character which uses the scale value of 1 through 7, which indicate the time it takes to complete daily tasks will decrease with the introduction of computerized electronic health records. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q21: Numeric character which uses the scale value of 1 through 7, which indicate computerized clinical healthcare systems, will increase the time it takes to complete daily clinical tasks. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q22: Numeric character which uses the scale value of 1 through 7, which indicate confidentiality is a major factor in determining information technology requirements for electronic health records. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q23: Numeric character which uses the scale value of 1 through 7, which indicate security is a major factor in determining information technology requirements for EHR. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q24: Numeric character which uses the scale value of 1 through 7, which indicate a computerized clinical healthcare system will produce useful patient data. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q25: Numeric character which uses the scale value of 1 through 7, which indicate using a wireless network connection to transmit patient information will create privacy risks. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q26: Numeric character which uses the scale value of 1 through 7, which indicate there is a need for computerization of patient health records. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q27: Numeric character which uses the scale value of 1 through 7, which indicate maintaining a secure environment for patient records is very important. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q28: Numeric character which uses the scale value of 1 through 7, which indicate maintaining computerized patient electronic health records (EHR) decreases medical errors. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q29: Numeric character which uses the scale value of 1 through 7, which indicate a personal digital assistant (PDA) will let me complete EHR tasks more efficiently. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q30: Numeric character which uses the scale value of 1 through 7, which indicate PDA's will have an interface that is easy to use. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q31: Numeric character which uses the scale value of 1 through 7, which indicate training in the usage of PDA's will not be required; I will be able to use the tool immediately. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q32: Numeric character which uses the scale value of 1 through 7, which indicate productivity will be increased with the use of a PDA for my day to day responsibilities. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q33: Numeric character which uses the scale value of 1 through 7, which indicate utilizing a PDA will decrease my productivity. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q34: Numeric character which uses the scale value of 1 through 7, which indicate the EHR system will increase our operating costs.

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q35: Numeric character which uses the scale value of 1 through 7, which indicate the quality of patient care will increase with the use of computerized tools. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q36: Numeric character which uses the scale value of 1 through 7, which indicate PDA's are confusing to use. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q37: Numeric character which uses the scale value of 1 through 7, which indicate training will be required in order to effectively use the PDA for patient data capture. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q38: Numeric character which uses the scale value of 1 through 7, which indicate the template that the computerized tool uses for patient data input makes it easy to recognize errors. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q39: Numeric character which uses the scale value of 1 through 7, which indicate if I become skillful with a computerized tool, this will cut down on the time it used to take to complete a task manually. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q40: Numeric character which uses the scale value of 1 through 7, which indicate I believe a PDA is adequate for the display of complex patient data. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

Q41: Numeric character which uses the scale value of 1 through 7, which indicate when handheld tools are used daily, updating data is critical for private patient data, billing and electronic health records (EHR) updates. The numbers represent the following:

1- Strongly Disagree
2- Disagree
3- Disagree Slightly
4- Neutral
5- Agree Slightly
6- Agree
7- Strongly Agree

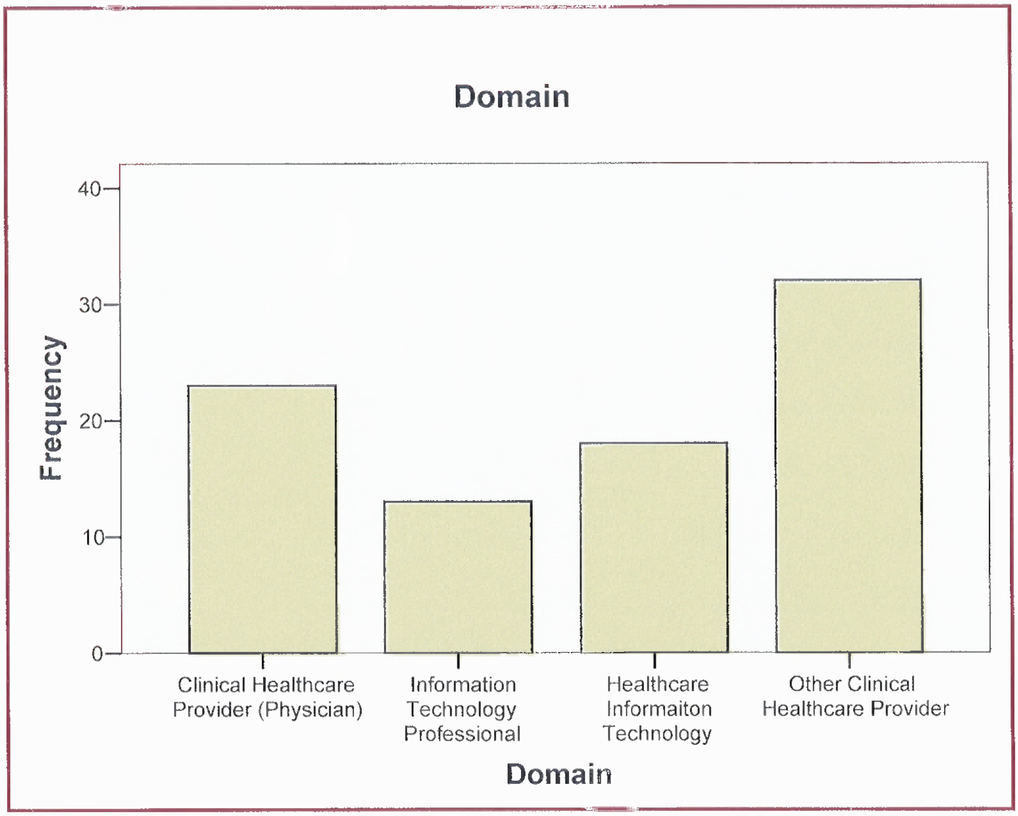
Q42: Numeric character which uses the scale value of 1 through 5, which indicate please answer the following question if you are using a Personal Digital Assistant (handheld). What is the procedure for updating patient data? The numbers represent the following:

1- Synchronization with main frame computer in Hospital or Clinic
2- Synchronization with server in medical practice or Internet provider
3- Synchronization with desktop computer
4- Synchronization with laptop computer
5- Synchronization with tablet computer

Q43: String of 200 characters that indicate has anything affected your patients' privacy or security in your work environment.

F.3.4 DESCRIPTIVE STATISTICS OF STUDY III PARTICIPANTS

Table F.31 Professional Domain.



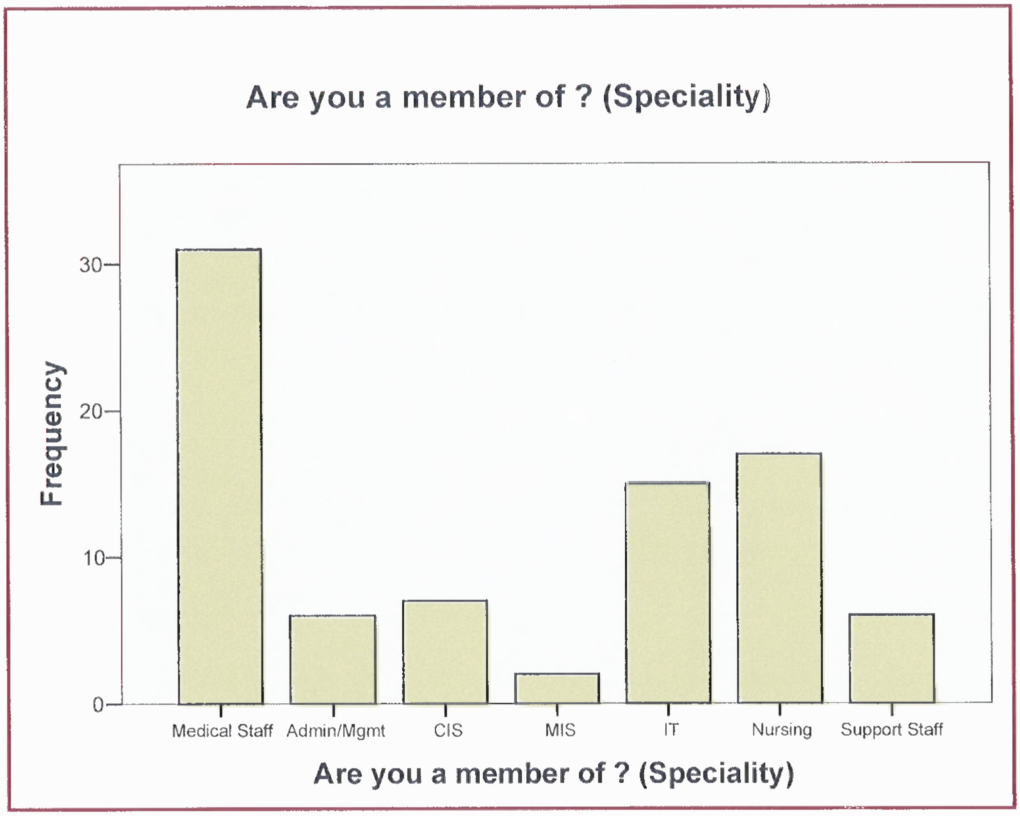
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Clinical Healthcare Provider (Physician)**	23	26.7	26.7	26.7
	Information Technology Professional	13	15.1	15.1	41.9
	Healthcare Information Technology	18	20.9	20.9	62.8
	Other Clinical Healthcare Provider	32	37.2	37.2	100.0
	Total	**86**	**100.0**	**100.0**	

Analysis:

The professional domains (Table F.31) that the 86 participants worked in during this research study make up the following statistical breakdown:

- Information Technology Professionals account for 15.1% of the sample or 13 participants.
- Healthcare Information Technology Professionals account for 20.9% of the sample or 18 participants.
- Other Clinical Healthcare Providers account for 37.2% of the sample or 32 participants.

Table F.32 Professional Specialty.



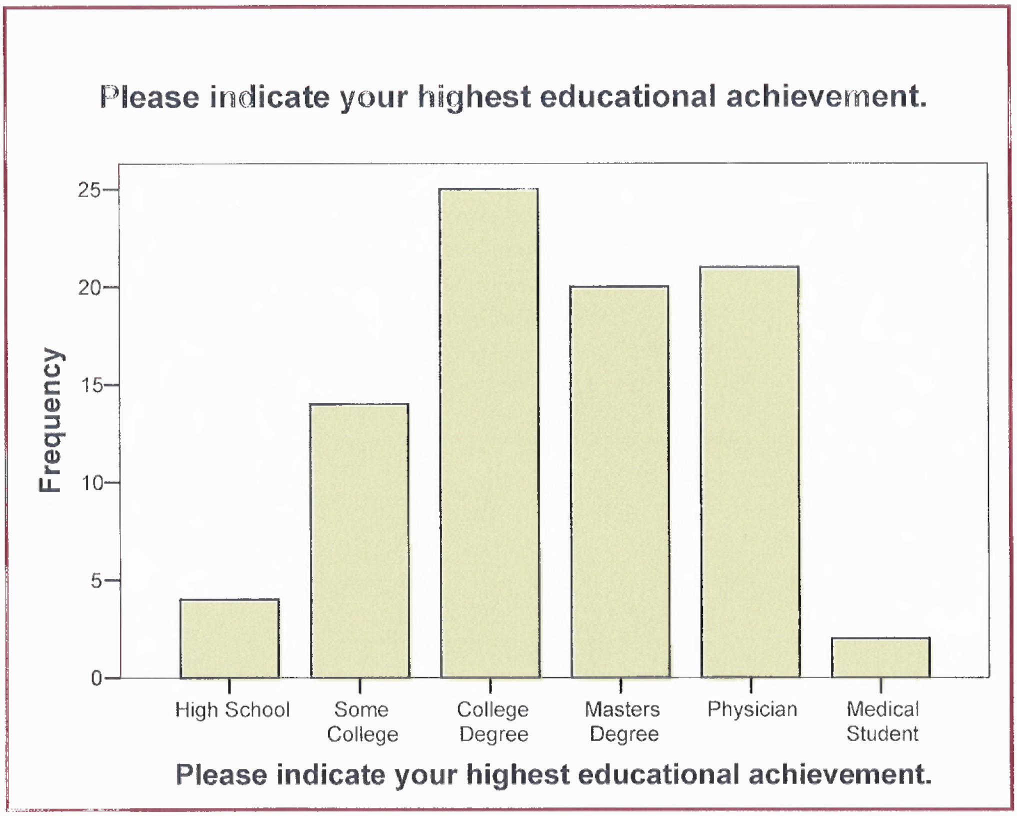
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Medical Staff**	31	36.0	36.9	36.9
	Admin/Mgmt	6	7.0	7.1	44.0
	CIS	7	8.1	8.3	52.4
	MIS	2	2.3	2.4	54.8
	IT	15	17.4	17.9	72.6
	Nursing	17	19.8	20.2	92.9
	Support Staff	6	7.0	7.1	100.0
	Total	84	97.7	100.0	
Missing	**System**	2	2.3		
Total		**86**	**100.0**		

Analysis:

The professional specialty within the specific domains (Table F.32) that the 86 participants worked in during this research study make up the following statistical breakdown:

- Medical staff accounts for 36 % of the sample or 31 participants.
- Administrative/Management accounts for 7 % of the sample or 6 participants.
- CIS – Clinical Information Systems accounts for 8.1% of the sample or 7 participants.
- MIS – Management Information Systems accounts for 2.3% of the sample or 2 participants.
- IT – Information Technology accounts for 17.4% of the sample or 15 participants.
- Nursing accounts for 19.8% of the sample or 17 participants.
- Support Staff accounts for 7% of the sample or 6 participants.
- Missing responses account for 2.3% or 2 participants.

Table F.33 Educational Achievement.



		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**High School**	4	4.7	4.7	4.7
	Some College	14	16.3	16.3	20.9
	College Degree	25	29.1	29.1	50.0
	Master's Degree	20	23.3	23.3	73.3
	Physician	21	24.4	24.4	97.7
	Medical Student	2	2.3	2.3	100.0
	Total	**86**	**100.0**	**100.0**	

Analysis:

This study had a highly educated sample population due to the group of Healthcare and Information Technology professionals participating (Table F.33).

- 79.1% of the sample population has a college degree:
- 29.1% or 25 participants have a BA/BS degree.
- 23.3% or 20 participants have a Master's degree.
- 26.7% or 23 participants have a medical degree.
- 20.9% are high school graduates and some participants have attended college.
    - This group represents 18 participants.

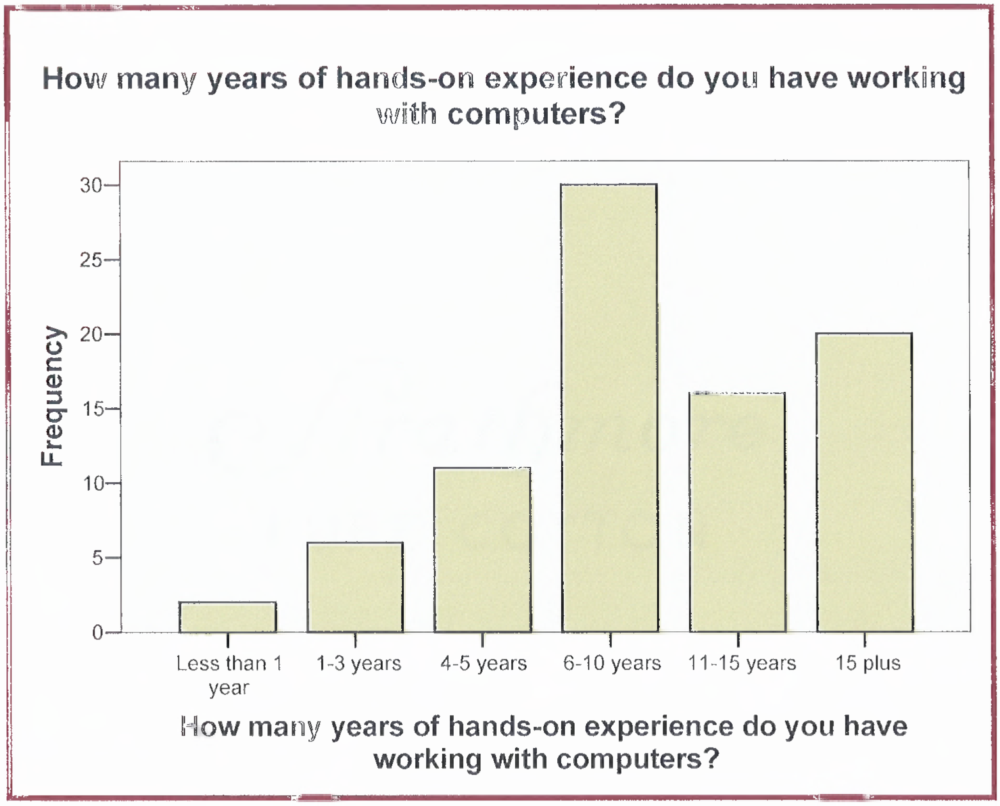
Table F.34 Medical School Attended and Year of Graduation.

What year did you graduate from medical school?														
Medical School Location														
	1970	1971	1976	1979	1980	1987	1991	1994	1995	1996	1997	1998	2008	Total
Baylor College of Medical Houston, TX			1											1
Calcutta Medical College Calcutta, India		1												1
Charles R. Drew Univ. of Medicine & Science, Los Angeles, CA						1								1
Howard Univ. College of Medicine Washington, DC									1	1				2
Madras Medical College, Madras, India								1						1
Michigan State Medical School, E. Lansing, MI					1									1
New York University School of Medicine New York, NY								1						1
Philadelphia College of Osteopathic Medicine Philadelphia, PA	1													1
Rajah Muthiah Medical College, India									2					2
Stanley Medical College, India				1										1
SUNY Downstate Medical College New York, NY												1		1
UMDNJ-New Jersey Medical School Newark, NJ					1			1		1	1			4
UMDNJ-Robert Wood Johnson Medical School Piscataway, NJ													2	2
University of Benia, Ebo State, Nigeria							1							1
University of Haiti, School of Medicine & Pharmacy, Port au Prince, Haiti		1												1
University of Texas Medical Branch Galveston, TX						1								1
University of Virginia, Charlottesville, VA								1						1
Total	1	2	1	1	2	2	1	4	3	2	1	1	2	23

Analysis:

- Physicians represented 26.7% of participants in this study (Table F.34).
- Only two participates reported having any information technology training.
    - One participated in bio-informatics research as part of an IT curriculum in medical school.
    - The other participant had on-the job training for the implementation of an Electronic Health Record system.

Table F.35 Hands-On Computer Experience.



		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	2	2.3	2.4	2.4
	1-3 years	6	7.0	7.1	9.4
	4-5 years	11	12.8	12.9	22.4
	6-10 years	30	34.9	35.3	57.6
	11-15 years	16	18.6	18.8	76.5
	15 plus	20	23.3	23.5	100.0
	Total	85	98.8	100.0	
Missing	System	1	1.2		
Total		86	100.0		

Analysis

Participants report that they have hands-on computer experience ranging from less than a year to over 15 years (Table F.35).

- 22.4% (19 participants) of the sample population report that their computer experience ranges from less than a year to five years.
- 34.9% (30 participants) of the sample population report that their computer experience ranged from six to ten years. This group is the largest in the sample.
- 18.8% (16 participants) of the sample population report that their computer experience ranges from eleven to fifteen years.
- 23.3% (20 participants) of the sample population report that their computer experience is fifteen plus years of experience.

F.3.5 HEALTH RECORDS (EHR) ADOPTION STATISTICS – CROSS TABULATIONS

Table F.36 Medical Records by Practice.

Case Processing Summary

Please indicate the type of practice in which you work. *

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Please indicate the type of practice in which you work. * Please indicate the approximate number of medical records in your system.	76	88.4%	10	11.6%	86	100.0%

Please indicate the approximate number of medical records in your system.

		Please indicate the approximate number of medical records in your system.				Total
		1-999	**1,000-9,999**	**10,000-99,999**	**Greater than 100,000**	
Please indicate the type of practice in which you work.	**Solo Practice**	4	0	0	0	**4**
	Group Practice	0	8	4	1	**13**
	Clinic	1	4	12	8	**25**
	Hospital	1	2	9	15	**27**
	Hospital Chain	0	0	4	3	**7**
Total		**6**	**14**	**29**	**27**	**76**

Analysis:

- This table (F.36) represents the number of medical records in the overall system. These records could be manual (paper) or electronic.
- The clinics, hospitals, and hospital chains had respondents from a mix of various departments within the specific domain. Therefore, the number of records in the system was representative of the area they represented for the study.
- The 10 missing responses throughout the EHR section (5.3) represent the practice that had a totally manual operation.

Table F.37 Percentage of Electronic Health Records by Practice.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Please indicate the type of practice in which you work. * Approximately what percentage of medical records in your practice comes from an EHR system?	75	87.2%	11	12.8%	86	100.0%

Please indicate the type of practice in which you work. * Approximately what percentage of medical records in your practice comes from an EHR system?

		Approximately what percentage of medical records in your practice comes from an EHR system							Total
		None	0%-19%	20%-39%	40%-59%	60%-79%	80%-90%	100%	
Please indicate the type of practice in which you work.	Solo Practice	0	2	0	0	0	1	1	4
	Group Practice	1	2	1	0	4	2	2	12
	Clinic	7	1	1	1	2	5	7	24
	Hospital	3	1	1	3	5	7	9	29
	Hospital Chain	0	0	0	0	2	2	2	6
Total		11	6	3	4	13	17	21	75

Analysis: This table represents the number of electronic medical records in the practice

Table F.38 Software Applications Developed and Programmed by IT Department for Practice.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Please indicate the type of practice in which you work. * To what degree are current software applications developed and programmed by IT department?	76	88.4%	10	11.6%	86	100.0%

Please indicate the type of practice in which you work. * To what degree are current software applications developed and programmed by IT department?

		To what degree are current software applications developed and programmed by IT department							Total
		None	0%-19%	20%-39%	40%-59%	60%-79%	80%-90%	100%	
Please indicate the type of practice in which you work.	Solo Practice	2	1	0	0	1	0	0	4
	Group Practice	7	1	0	2	1	1	0	12
	Clinic	3	2	1	5	4	2	8	25
	Hospital	4	10	3	4	4	3	0	28
	Hospital Chain	0	1	2	3	0	1	0	7
Total		16	15	6	14	10	7	8	76

Analysis: This table represents the number of practices that had an in-house IT department that developed and programmed applications.

Table F.39 Proprietary Software Applications by Practice

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Please indicate the type of practice in which you work. * To what degree are current software applications proprietary?	74	86.0%	12	14.0%	86	100.0%

Please indicate the type of practice in which you work. * To what degree are current software applications proprietary

		To what degree are current software applications proprietary							Total
		None	0%-19%	20%-39%	40%-59%	60%-79%	80%-90%	100%	
Please indicate the type of practice in which you work.	Solo Practice	1	0	1	0	0	0	2	4
	Group Practice	0	1	0	2	0	1	9	13
	Clinic	3	1	5	5	1	5	3	23
	Hospital	1	1	0	4	2	16	3	27
	Hospital Chain	0	1	0	0	2	2	2	7
Total		5	4	6	11	5	24	19	74

Analysis: This table represents the number of practices that have software application developed by proprietary vendors.

APPENDIX G

OVERVIEW OF STUDIES

Appendix Sections G.1 to G.2.2 represents a chronological overview of Study II through Study III.

APPENDIX G.1 PILOT STUDY II - STRUCTURED INTERVIEWS

Two structured interviews were conducted with stakeholders responsible for Information Technology acquisitions in their respective facilities. This pilot pre-test of Survey II (see Appendices C.2 – C.3) was conducted December 21 - 27, 2005 with a chief information technology officer and a pediatrician, both of whom work in New Jersey. The survey was conducted to test a theory that attempts to explain the perception between Information Technology developers and the technology required by clinical healthcare providers to do their daily tasks. The interviews were done to evaluate these stakeholders' attitudes regarding the adoption of Information Technology, electronic health records (EHR), and mobile applications within their work environment.

Eight additional surveys were conducted after analyzing the data and responses from these two primary stakeholders, which included updating the survey. A transcript of the stakeholders' structured interviews is followed by analysis of the data collected during each interview.

G.1.1 TASK LIST

Subjects are asked to perform the following tasks as part of this study:

1. The subject is given a brief overview of the research mission verbally and told what will take place during the 30 - 60 minute interview. Subjects are encouraged to ask questions at this point.
2. A copy of the "Research Introduction Letter" (Appendix A.2) is given to the subject(s) so that they can get an explicit idea about why I am conducting the study, and to know what is being asked of them as participants.

3. Next, a copy of the "Consent to Participate in a Research Study" form (Appendices B.2 – B.3) is given to the subject(s) to let them know their rights as participants. Once the subjects read the consent, they are asked to sign the form which indicates that they are willing to participate in the study.
4. The signed consent forms are collected. If there is a group of subjects, one person is asked to collect the forms and place them in a pre-paid envelope address to a committee member.
5. A copy of the survey (Appendices C.2 – C.3) is handed to the subject(s), who are asked to spend a few minutes reviewing it. This is done to determine if there is anything that needs to be explained prior to the participants' writing their responses.
6. These structured interviews were conducted in a one-on-one environment where the subject was asked to "think out loud" while answering the questions on the survey. The Principal Investigator (PI) organized the responses and notes according to which question number was being addressed.
7. Conducting these interviews permitted the PI an opportunity to gain insight into the developmental issues that were critical to each subject's operation and delivery of quality of patient care.

G.1.2 STAKEHOLDERS' RESPONSES

Two major stakeholders were interviewed regarding their opinion of Information Technology requirements and their visions for their organizations.

G.1.3 STAKEHOLDER 1:

<u>Background Information On Subject:</u>

Stakeholder number one is a male, Chief Information Officer (CIO) for a health care system in Morris and Sussex Counties, where he is responsible for information technology innovations for four hospitals within this health care system. He has a

Master's degree and fifteen years of information technology experience in which he considers himself to be an "expert," and approximately three years in clinical healthcare where he considers himself "very" knowledgeable.

Brief Overview/Clinical Environment:

The CIO for this facility is in the process of implementing the following clinical information systems for three of the four hospitals within the health care system he oversees:

- * Computerized Physician Order Entry System (CPO)
- * Electronic Medical Records (EMR)
- * Pharmacy System
- * Radiology System
- * Critical Care System (Intensive Care Unit – ICU)
- * Emergency Department System
- Picture Archiving and Communication System (PAC) - Digital Radiology
- Quality Management
- Medical Records Management Tracking System

*The Denville Hospital implemented of all the above systems in October 2006. Simultaneously the Dover and Sussex hospitals will be part of the initial rollout, but will be limited to only the systems marked with an asterisk (*) above. In November 2006 the remaining systems will start in Dover and Sussex. The health care system has not scheduled a date for the rollout of systems for their Behavioral Health Hospital in Boonton.

In-Depth Interview:

Stakeholder 1 was the initial contact for participation in this experiment. As he reviewed the survey, his preliminary comment was that he thought these "were extremely good questions." This subject works between both domains (information technology and clinical healthcare) on a daily basis; he indicated that at present "60% – 80%" of clinical healthcare applications are from information technology systems. This number will change to "100%" when the implementation of the above stated systems is completed. This subject uses a PDA and a laptop in the information technology setting "the entire day."

The preferred size of a computerized tool that this subject would recommend for clinical healthcare providers to "carry" was a "tablet," and the "largest" size device that he felt would be acceptable for them was a "mobile cart." In regard to converting from a "manual system (pen/paper)" to a computer information system and the effect on the delivery of clinical healthcare services, the subject indicated that the following would be achieved: "More secure, friendly, (but) difficult to use until the users are trained. Privacy was a major concern. Usefulness, compatibility and reliability were expected to result from computerization." The need for checks and balances within clinical healthcare systems that deal with patient prescriptions, ordering tests and data reporting would have to be: "More secure, friendly, easy to use. Privacy was a major concern; usefulness, compatible and reliability were expected to result from computerization." Subject 1's concern about "Security and Confidentiality" was reflected in his answers to the question that asked "What would a clinical healthcare system require for secure and confidential data?" The subject indicated the highest level regarding the following constructs that are adhered to: more secure, private, useful, compatible and reliable. Friendliness and ease of use are constructs that imply flexibility for system applications; however, these applications need to be a little more rigid to deter penetration in order to maintain secure and confidential patient data.

At the Subject's organizations, "20%" of the current software applications are developed by the Information Technology Department and "80%" are purchased from outside vendors. User participation is encouraged when clinical healthcare applications are developed; Subject 1 indicated that healthcare professionals are "Fully consulted at all levels."

Analysis:

The first page of the survey (also for this structured interview) makes a distinction between information technology and clinical healthcare providers so that empirical data can be analyzed. On this page the subject was able to supply background information (demographics) for the Investigator. As the CIO, this stakeholder is on the developmental side of the organization where he makes determinations on the information technology that will be acquired, programmed and implemented in clinical healthcare departments.

Subject 1 is very knowledgeable about information technology and understood the area being researched. He was very helpful when "thinking out loud" as he answered the questions. These pauses helped me rephrase a few questions and/or reverse scales to get richer data. For the questions that related to "Private and Public," the constructs were changed to "Private within the Organization" and "Public outside the Organization" to make the responses clear. Another question was deleted and one that was specific to information technology was rewritten to create the same question for clinical healthcare providers.

In this healthcare environment, while "cost" was indicated as a major impediment to the adoptions of clinical healthcare systems, the need for computerization was made apparent by the CIO of this organization. Interoperability, or the processes of technological integration of new applications into existing organizational information technology environments, creates issues of adaptability (when new or existing application systems are not flexible). Therefore, it was stated that integration into existing systems must be a primary factor when systems are designed. The Subject "strongly agreed" that the adoption of information technology for clinical healthcare applications would "increase productivity", "decrease medical errors" and the "decrease time" it takes to complete daily clinical tasks.

The "need for computerized patient health records was strongly agreed" upon as a major requirement, as was being able to "generate useful patient data while maintaining a secure environment." "Security and confidentiality" issues are constructs that must be adhered to when patient data is being viewed or transmitted over the Internet. These issues have been addressed by the CIO of this healthcare facility and by federal legislation in the following ways:

- Vendors must sign a "HIPAA Business Association Agreement," a legal requirement that allows them to access secure data and applications that they are developing for the organization.
- Vendors are subjected to spot audits and ongoing HIPAA monitoring.
- This facility has the following personnel on-site:
  - **HIPAA Privacy Officer** – Focuses on the patient and the patient's confidential records as required by HIPAA Legislation.
  - **HIPAA Security Officer** – Ensures protection of privacy through technological means; i.e., making sure that people do not have unauthorized access to the computer system (network). Maintains the system free from intrusion.

G.1.4 STAKEHOLDER 2:

Background Information On Subject:

Stakeholder number 2 is a female pediatric physician who has been practicing medicine for five and a half years with approximately ten years of computer experience. She considered herself to be "very" knowledgeable about clinical healthcare applications.

Brief Overview:

Subject 2 established a pediatric practice, where she is a partner, in April 2005 in Union County. Currently the practice is undertaking the implementation of an Electronic Medical Records (EMR) system for the office.

Practice Setting:

This practice employs two physicians, one medical assistant/office manager and one billing officer. Stakeholder 2's practice currently has in place a billing system and maintains a subscription to an on-line internet service. Following are services that are being used in the practice:

- MISYS-TIGER Billing System – administers patient billing.
- MD Consult: Paid subscription to a website www.mdconsult.com
  - The physicians have access to this site based on a user logon and password.
  - They have access to textbooks, research articles, drugs and patient education for each medical field and related practice guidelines.
- MEDI-EMR Corporation - Electronic Medical Records implemented in their practice: www.mediemr.com.
  - MEDI-EMR has started implementing templates for charts, patient scheduling, prescription writing and generating bills that link to their billing system (MISYS-TIGER).

In-Depth Interview:

Stakeholder 2 primarily works in clinical healthcare where she treats patients on a daily basis in her private practice and a pediatric clinic. After reviewing the survey, she immediately asked me to explain the differences among information technology, clinical healthcare, and computer information systems as they related to the survey. The Subject was then able to tell me the services that her practice uses and what they are currently purchasing for implementation. To date, "40%" of clinical healthcare applications are from outside information technology vendors. This number will change to "100%" by February 2006 when the implementation of Electronic Medical Records was completed.

This Subject uses a "desktop computer" in the clinical setting "hourly," and the services of www.mdconsult.com for professional updates and information every "2-3 days". Subject 2 indicated she would like to have "laptops" for home and the office and a "PDA" for hospital usage when doing patient visits (rounds). However, she has concerns about the efficiency of the "PDA" when it comes to Electronic Medical Record security. The "mobile cart" was considered too awkward in cases of emergency treatment and the "tablet" was evaluated for her practice but deemed too fragile.

The preferential size of a computerized tool that this subject would "carry" would be a "PDA or laptop" and the "largest" size device that she would accept would be a "laptop" for clinical healthcare applications. The qualifier on the PDA for Subject 2 would be to address the "security/confidentiality issues for patient records" that concern her about the tool. In regard to converting from a "manual system (pen/paper)" to a computer information system and the effect on the delivery of clinical healthcare services, the subject indicated that the following would be achieved: "More secure" scored in the middle range. "Friendliness" was scored as a high priority. "Easy to use" scored in the middle range with a notation that it would be less difficult once the users are trained. "Privacy was a major concern." "Worried about someone being able to hack into the EMR system"; "Usefulness and compatibility" were expected to result from computerization. Reliability was scored in the middle range with the following comments from Subject 2: "I am feeling very insecure because our EMR is Internet-based. My worries center on not being able to access my patients' records if the Internet is down. I feel as if my patients' medical records are being held hostage by an outside source." The need for checks and balances within clinical healthcare systems that deal with patient prescriptions, ordering tests and data reporting would have to be: "More secure, friendly, easy to use, private, useful, compatible, and reliable." These attributes "were expected to result from computerization." These constructs were all scored with the highest value by this Subject.

Subject 2's response to the question that asked "What would clinical healthcare systems require for secure and confidential data?" indicated the highest level stating all constructs must be adhered to: "More secure, friendly, easy to use, private, useful, compatible and reliable."

Subject 2's practice has "40%" of their current software applications developed and purchased from outside vendors (see list that follows in Analysis Section). In the next four to six weeks this practice was automated "100%" (Feb 2006). Subject 2 indicated that she and her partner, as users of the developed clinical healthcare applications were "fully consulted at all levels." She indicated the following information for this question: "Our practice happens to be the test office for MEDI-EMR; we are the first medical office that they are implementing Electronic Medical Records (EMR) for. Previously this corporation's contacts were in the financial industry." Subject 2 went on to say "The biggest issue the practice has had with the implementation of the EMR System has been the misperceptions that the MEDI-EMR programmer has about what our needs are."

The first page of the survey makes a distinction between Information Technology and Clinical Healthcare Providers so that empirical data can be analyzed. On this page the subject was able to supply background information (demographics) for the Investigator. This Subject is a user of information technology and makes determinations regarding what will be acquired, programmed and implemented in her clinical healthcare practice.

In this Subject's work environment, desktop computers are currently being used and were indicated in the "other" category. The survey did not list this category; however, desktops have now been added as a category on the survey. While our initial approach was to determine mobile tools, the survey was updated to include what users are currently using as they move into other modes of IT adoption.

In this clinical healthcare provider's practice, "cost" was indicated as a major impediment to the adoptions of clinical healthcare systems; however, the need for computerization was crucial. Interoperability, or the processes of technological integration of new applications into existing applications, has created a problem for this practice (See Major Concerns below). Subject 2 "strongly agreed" that the adoption of information technology for clinical healthcare applications would "increase productivity", "decrease medical errors" and decrease the "time" it takes to complete their practice's daily clinical tasks. The "need for computerized patient health records was strongly agreed" upon as a major requirement as was being able to "generate useful patient data while maintaining a secure environment." "Security and confidentiality" issues are constructs that must be adhered to when patient data is being viewed or transmitted over the Internet. This has created major concerns for the physicians in this practice that is in the process of converting from a manual medical records system to an electronic medical records system with an outside vendor. MEDI-EMR built their templates so that they finished the computerization of their patient records by February 2006. These issues have been addressed by this physician's practice and federal legislation in the following ways:

- HIPAA compliant as well as maintaining compliancy when sending prescriptions over the Internet and sharing patient information with other physicians and providers of care in a clinical healthcare setting;
- Maintenance of different levels of security clearance within the practice based on passwords and firewalls.
- Maintenance of confidential patient data transmitted and received from laboratories;
- Establishment of 24-hour access with a temporary password to allow viewing of patient's electronic medical records by a referred specialist.

Additional issues that were addressed are listed below and are sprinkled throughout Subject 2's interview. Listed in the section that follows are issues that this Subject is currently grappling with as the automation of her practice is underway.

Major Concerns of Stakeholder 2:

- MISYS-TIGER Billing System, which has been used in their practice since 2005, is currently having problems interfacing with HL-7, so the practice is currently having problems with the MEDI-EMR interface. This is an interoperability issue.
  - This situation might result in legal issues because MISYS-TIGER'S contract states that they are able to interface with HL-7.

- MEDI-EMR Programmers had misperceptions regarding their specialized needs for patient records and pediatric care. For example, "Problem List" is a chronological list of all patient visits, sick or well, in the order of occurrence to the physician's office. While designing the templates for the practice, MEDI-EMR thought it was a computer-generated list of chronic problems (diabetes, asthma, high blood pressure). This issue reinforces the need for requirements analysis and user participation for developers who design and program systems for physicians' offices.

  - Active participation of doctors is necessary in the development of their office system(s) based on their "unique" requirements for their practice.

- MEDI-EMR has an internet server, but the practice does not have a server in their office; therefore, Subject 2 has concerns about reliability if the company goes bankrupt; will their *"information be held hostage"*?
  - Medical records will not physically be in their office; they will access them virtually. This could be a problem when the internet connection is unavailable.
  - Currently, the records are in manual form in their office.
- There are risks associated with using a wireless network connection (PDA) when transmitting patient information. Wireless systems can be hacked; open architecture and Bluetooth issues create concerns about privacy risks when patient information is passed through the airways.
- There are thoughts about the proprietary companies who provide services. For example, if the company ceased to exit or went bankrupt, there is a significant risk of the patient data being held hostage or being inaccessible to the practice.

G.2 OVERVIEW OF STUDY III

G.2.1 STAKEHOLDER'S CONTRIBUTION

The transcripts from these structured interviews assisted with restructuring the questionnaire for the third study (Appendices C.4 – C.5). The final instrument was tested at a physicians' practice to evaluate the responses to the questions asked and to maintain a time limit of less than 15 minutes for survey completion.

The initial instrument was refined, condensed, and validated through several stages of data collection and analysis. Data for refining and testing the instrument were obtained from healthcare and information technology professionals spread across the following domains (focus group):

- Chief Information Officer
- Vice President of Nursing
- Clinical Information Technology Director
- Group Practice Physician
- Family Practice Physician

G.2.2 STUDY III

Input from several different focus groups which included UMDNJ, Montclair Family Health Center, Trinity Pediatrics, and Saint Clare's, IT and healthcare professionals were instrumental in the construction of the final survey (Appendices C.4 – C.5) Two stakeholders responsible for Information Technology acquisition participated in structured interviews which were further tested with the assistance of a family practice physician (Appendices C.4 – C.5). This physician evaluated the survey to ensure the questions targeted towards clinical healthcare providers were represented and to ensure that a 15-minute time frame was adhered to for completion. The Flesch-Kincaid Readability Test (Cooper and Schindler, 2001) was used to determine the level of reading difficulty for the survey participants (Reading Ease 38.3 and Grade Level 11.5).

Study III was updated to include questions that tested the WOSP model and perceptions about IT adoption in a clinical environment with regard to:

- Electronic Health Record Adoption
- Security (WOSP)
- Privacy (WOSP)
- Mobility
- PDA Use
- TAM2 (Usability and Ease of Use)

Constructs for each of these variables are included in Appendix D.2 where each question is linked to a construct. Researchers and a physician wrote an appeal letter that accompanied each mailing and/or was given to every participant who completed the survey (see Appendices A.2 – A.5). The Flesch-Kincaid (Cooper and Schindler, 2001) scores are as follows, (Reading Ease 32.9 and Grade Level 12.7).

APPENDIX H

RESPONSES REGARDING HEALTHCARE CONCERNS – STUDY III

Appendix H represents chronological tables (H.40 – H.45) with responses to questions that were collected from various professionals for Study III.

APPENDIX H.1 RESPONSES REGARDING HEALTHCARE CONCERNS

A mass email was sent to a broad spectrum of professional people (60% replied); asking them to respond to the following questions:

"What is your primary concern regarding your health information and the physician(s) you see for treatment. Please note I am not asking for personal data, but for any question(s) that you have that are of concern when you see your physician, are hospitalized, and/or prescribed medications."

This question was posed to glean an understanding of concerns and major issues confronting individuals when seeking care for their self or for a family member. Each reply was copied to a word file where a code number was assigned; the original email with identifiable information about the participant was deleted. No demographic data on the participant were captured to maintain anonymity.

The response from this data collection was compiled into the tables (Tables H.40 – H.45) that are on the proceeding pages and listed by three categories (Electronic Health Records (EHR), Confidentiality/Privacy/Security and Miscellaneous categories)).

Table H.40 Responses – Healthcare Concerns.

Respondent Number	Electronic Health Records (EHR)	Confidentiality/Privacy /Security	Miscellaneous
1.	My primary concern is that physicians have ready access to both my current and historical personal medical information, as well as the most up-to-date developments in their area of specialization and related areas to ensure that I am provided optimal care and treatment.		
2.			Is my drug information made available to pharmaceutical companies?
3	What policies and procedures does the health care provider have in place to ensure that my personal health data and information is kept confidential and is not being misused?		
4.		What training has the staff been provided with regarding HIPAA and other privacy and security requirements, to ensure that my information and data are kept confidential?	
5.	Is there a way that they can achieve a system where one's medical records are consolidated into one file (i.e., from birth to the present)? That way when you see a doctor you would have a copy of everything together.		
6.		How safe are my medical records?	
7.		How is the data stored and how is it backed up?	
8.	Who has access to my medical data?		
9.	Can I get a copy of my medical records by simply asking for a copy?		

Table H.41 Responses – Healthcare Concerns.

Respondent Number	Electronic Health Records (EHR)	Confidentiality/Privacy /Security	Miscellaneous
10.			Why don't prescription drugs cure the disease, they only suppress the disease (bandage the disease)?
11.			Why is it that certain prescription drugs are illegal in the U.S. and legal in other countries that will actually cure a disease(s)?
12.			Why are pharmaceutical companies spending billions and billions of dollars on research and patents and not coming up with a cure for diseases (Cancer, AIDS, and Heart Disease)? Is it all about the billions? That is, billions of dollars that are being pocketed by government and politicians?
13.			Why are physicians in a rush to prescribe a prescription drug with numerous side effects and not getting down to the root of an illness or disease?
14.	The use of information technology could be employed in the emergency room to record whether doctors make correct diagnoses and correct recommendations for hospitalization based upon the symptoms displayed by the patient. This is usually a private area of information that no one questions because the doctor makes this determination. However, when doctors are tired or sleepy, they could make incorrect diagnoses. Having an information system of this type could possibly save lives.		

Table H.42 Responses – Healthcare Concerns.

Respondent Number	Electronic Health Records (EHR)	Confidentiality/Privacy /Security	Miscellaneous
15.	An information system that contains all medical information about patients. It should be readily available to a physician via the patient's social security number which could possibly prevent a doctor from giving a patient the wrong medicine or give a patient the right medicine right away. However, this may be a solution that violates a patient's right to keep their information private unless there was a password attached that only the patient or close relative could activate.		
16.	Here at the university, student records are kept in folders in the health center's reception area. The folders are kept in a locked cabinet, but during normal working hours, they are all open since patients come and go. The records are not electronic. Only your name and contact information are stored in the computer for making reservations and storing insurance info. When I get referrals to specialists, the specialists have no access to my medical records. The student health center doctor will write up a referral sheet with her diagnosis and results of tests she already performed. But, the specialist does not see my past medical history.		

Table H.43 Responses – Healthcare Concerns.

Respondent Number	Electronic Health Records (EHR)	Confidentiality/Privacy /Security	Miscellaneous
17.			Side effects of the medicine prescribed. A lot of times you are told what the "common" side effects are and not about those the doctor feels are not as prevalent, but the patient needs to know that if they start to experience these lesser known symptoms they will be aware that it could be related to the medicine and not assume it isn't. This includes side effects that may occur while taking the medication and those that may occur after discontinued use of the medication (say for example after prolonged use).
18.		The patient's right to obtain a copy of their medical records should they request it. With respect to modern technology and medical advances, how come there's not one universal database which could provide all of a patient's pertinent medical history? If TransUnion, Experian, etc. are able to trace our credit histories, how come the same can't be done for data pertaining to our health?	
19.		Why is it that I have to sign a release form for my doctor to release my medical information and then that information is stored on a database for the primary insurance companies to make decisions should they pay that claim? In other words the information should only be released for the claim issued at that time, not prior claims.	

Table H.44 Responses – Healthcare Concerns.

Respondent Number	Electronic Health Records (EHR)	Confidentiality/Privacy /Security	Miscellaneous
20.		HIPPA law instructions are to not speak of a patient's medical history but all that info is sitting out there for anyone to get.	
21.			My primary concern when prescribed medication by my physician is his/her lack of concern of the adverse side effects that a prescription may cause. For instance, when I asked my health care provider about the side effects of a particular prescribed medication, her response was not to worry about it. Another medication can be prescribed to help with the side effects. This response caused me to feel as if the medication was more important than her concern for my overall well being.
22.			Does my doctor have enough time to really talk to me about my concerns?
23.		Who other than the doctor has access to my files? Are they in a secure place?	
24.			Are you on any medications or remedies?" Granted, this doesn't relate directly to the security or privacy of medical records, but it certainly reflects how little time physicians have (or take) to review a patient's records or history
25.	Is my doctor aware of my previous medical history beyond what I tell him during visits? What I mean is does he/she have access to my previous medical records?		
26.			Has my doctor had malpractice suits and what were the outcomes?
27.			Does my doctor hold any racial bias which may affect my treatment?

Table H.45 Responses – Healthcare Concerns.

Respondent Number	Electronic Health Records (EHR)	Confidentiality/Privacy /Security	Miscellaneous
28.			Prior to my son's diagnosis with Crohn's Disease, why did my doctor ask me about child abuse, child molestation, and drug abuse? Are these normal questions or are these based on stereotypes that he/she has about the Black community?
29.			How many hours of sleep does my doctor get a night? Is he/she happy?
30.			What can be done in the event of an emergency if a person is unable to respond to questions about allergies, for example?

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