Walden University

COLLEGE OF MANAGEMENT AND TECHNOLOGY

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ABSTRACT

Factors Affecting the
Technology Readiness of Health Professionals

By

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MA, Occidental College, 1975
BA, California State University at Dominguez Hills, 1971

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Federal government policies are promoting diffusion of technologies into the healthcare system. If health professionals reject the new technologies planned for the healthcare system, it could result in costly failures, delays, and workforce problems. There is a lack of knowledge about factors that affect technology readiness (TR), defined as the predisposition and attitudes of health professionals regarding new technologies. This study utilized a quantitative survey design to investigate the factors that contribute to TR by examining how a sample of health professionals perceived relationships among TR and four variables of optimism, innovativeness, insecurity and discomfort. The theoretical framework is based on Rogers' theory of diffusion of innovations, Fishbein's theory of reasoned behavior, Kuhn's theory of paradigm shifts, Mick and Fournier's theory regarding paradoxes and technology, and Parasuraman and Colby's theory of TR. Significant correlations were found between TR and optimism as well as TR and insecurity/discomfort; no significant relationship was found between TR and innovativeness. The sample tested high in TR regarding optimism towards new technologies, and showed both positive and negative attitudes towards individual innovativeness. ANOVA analyses found no significant differences in responses based on gender, age or race. Positive social change may result from this study if health institutions utilize the findings to establish training programs for health professionals that promote positive TR through education, provide incentives to encourage early adoption of new technologies, and address insecurities, discomfort and fears regarding new technologies.

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Dedication

This dissertation is dedicated to Roy J. Myers, my husband, mentor, and best friend. Thank you very much for your generous support, steadfast vision, inspiration and encouragement. It is my hope that our joint effort and your vision and inspiration for my pursuit of a doctorate will be motivating for future generations. It would not have been possible without you.

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Chapter 1: Introduction to the Study

Factors That Affect Technology Readiness

There is significant research regarding diffusion of technologies into the healthsector. Few studies, however, have addressed the technology readiness (TR) of health professionals. TR is defined by Parasuraman & Colby (2001) as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (p. 18). Health professionals are an essential component of the healthcare workforce, and their capacity and willingness to use new technologies is relevant to implementation of new technologies in health. In 2009, the importance of determining TR among health professionals was illustrated when the federal government announced $1.2 billion in grants to help hospitals and health providers install electronic medical records for patient safety, billing, and healthcare management (White House Press Office, 2009).

This quantitative study surveyed a random sample of health professionals to assess their attitudes and predispositions regarding TR and the dependent and/or independent effect of four variables on their TR. The study presented descriptive categories of qualities of technology adopters, issues for consideration regarding diffusion of technology into society, and evaluation of TR theories in the context of survey results.

Background

World Health Organization (WHO) policymakers believe there is urgency for health technologies to be adopted worldwide in healthcare. They stated:

> Health technologies are developed to solve a health problem and improve quality of lives. They form an indispensable component of the services health systems

> can offer in the prevention, diagnosis, and treatment of disease and in alleviating disability and functional deficiency. Access, including in primary health care, to safe and effective health technologies relies on policies for selection and management based on scientific evidence and best practice for organization of their management and use (World Health Organization, 2009).

Health technologies are part of a healthcare system consisting of one of the largest workforces in the United States. In 2006, the health system provided 14 million jobs in the economy including salaried workers and self-employed contractor businesses who worked in approximately 580,000 establishments (U.S. Department of Labor, 2009). The health workforce continues to grow with 7 of the 20 fastest growing occupations projected for the health sector over the next decade generating as many as 3 million new jobs (U.S. Department of Labor, 2009).

In 2009, the Bureau of Economic Analysis reported the gross domestic product (GDP) of the health industry at approximately $ 580 billion dollars (U.S. Department of Commerce, 2009). In spite of the economic downturn in 2009, the health and social assistance sector experienced an increase of 4.6% (U.S. Department of Commerce, 2009). The GDP figure included healthcare, social assistance, ambulatory health, hospitals, nurses, residential care facilities and other health providers (U.S. Department of Commerce, 2009). All of these heath institutions are increasing their use of technologies such as medical informatics, telemedicine, radiology, dentistry, surgery, pharmacy computerized medical devices, assistive technology and prosthetic devices (Burke & Weill, 2005).

One motivation for integrating technologies into healthcare was supported by findings regarding patient safety in a report issued by the Institute of Medicine (1999) that indicated between 44,000-98,000 people in the United States died from medical errors each year. The report concluded that one method of reducing medical errors and improving patient safety was to develop and test new technologies that could be integrated into various facets of the health system (Institute of Medicine, 1999). Recommendations from the Institute of Medicine report led to federal actions to implement new technologies, including funding from the U.S. Department of Health and Human Services to promote electronic records (2009) and $157 million in funding from the U.S. Veterans Administration to promote electronic medical records, personal digital assistants (PDAs), and other medical technologies (U.S. Veterans Administration, 2010). Research indicates that reduction of diagnostic medical errors can be achieved through increased use of information technology (Singh, Naik, Rao, & Petersen, 2007).

The proliferation of technology among patients who use information technology for time management, scheduling medical appointments, monitoring chronic conditions, and accessing information for difficult-to-treat medical conditions demonstrates the need to understand TR among health professionals. TR is a necessary capability for health professionals who are responsible for responding to patient needs (Goldzweig, Towfigh, Maglione, & Shekelle 2009). For example, patients high in TR could have expectations that health professionals they interact with have the capacity to use health information technologies (HIT) such as email, electronic medical records, world wide web, electronic databases, robotic surgical and/or innovative medical instruments. If patients with high

TR encounter health professionals with low or negative TR, this difference could affect their confidence in their provider and patient care. The literature review in Chapter 2 further substantiates the significance of understanding TR and the impact of diffusion on society and summarizes perspectives on the introduction of technology into social systems.

Problem Statement

The federal government could benefit by increased knowledge of the technology beliefs and TR of health professionals in order to implement new national health initiatives successfully. Without TR, health professionals could reject new technologies or adopt them slowly, resulting in workforce problems, including costly failures and/or delays in implementation of innovations in health systems.

Gaps in knowledge regarding the factors that impact attitudes, characteristics and judgmental capacity of health professionals towards technology and TR call for study. If health professionals are technologically ready and predisposed to accept innovations and technologies, then integration of technology into the healthcare sector could progress smoothly. However, if segments of health professionals demonstrate that they are not technologically ready or are resistant to adopting new technologies, then a societal problem exists. Such a societal problem could be affected by increased demands for healthcare by growing elderly populations and increased needs for improved healthcare management due to rising costs, patient safety, and medical errors.

There are anecdotal indicators that indicate technology unreadiness among leading health professionals. For example, in 2007 Dr. Joseph Heyman of the American Medical Association said:

> We worry that there is such frustration out there right now with Medicare payments that adding a mandate would be something that would cause some physicians to just throw in the towel...the technology is not as simple as advocates suggest. (Retrieved from National Public Radio Interview, 2007)

Heyman's observation that technology was not as simple to use as advocates suggested indicated a measure of discomfort with technology that could be shared by other physicians and health professionals.

If findings in this study indicate there is a significant lack of TR among the critical workforce of health professionals, there may need to be modifications made in TR education and training. Changes in training that increase positive TR among health professionals could assist to avoid potential systematic disruption and inefficiencies that could result from rejection of the rapid diffusion of new technologies. If findings show there is positive TR among a sample of health professionals, then national efforts to accelerate diffusion of technology may have the potential for success.

Nature of the Study

The survey instrument used to compile quantitative data for the current study was the TR Index (TRI), a survey tool copyrighted by Rockbridge Associates and developed for the marketing industry with rare applications to the to the health sector (Parasuraman & Colby, 2001). A sample of 72 health professionals from 25 states participated in the

study by responding to questions regarding their attitudes and predisposition towards new technologies. Results from this research could aid in institutional decision regarding methods that can improve TR among health professionals. By determining the positive and/or negative factors that influence adoption or rejection of new technologies, decision-makers could have increased knowledge regarding the methods, tools, education, and training that can achieve technology-related objectives in healthcare.

One rationale for this study was based on federal goals to reduce health costs, prevent medical errors, decrease paperwork, improve efficiencies, improve quality of care, and expand access to care. The diffusion of health and medical technologies and health information technologies (HIT) include different technologies that require different skills. Health and medical technologies include computer-assisted surgical tools, robotics, biotechnology, assistive technologies and other equipment, while HIT includes information-based technologies such as electronic medical records, telemedicine, personal digital assistants, email, and databases (Burke & Weill, 2005). These technologies range from easy to understand and use to difficult levels of innovation that require additional training, and these factors contribute to the cooperation or lack of cooperation of health professionals based on their TR attitudes and willingness to accept and learn new technologies.

Another rationale for this study is the federal emphasis on HIT as evidenced by the 2009 establishment of a specialized information technology office known as the Health IT Project in the Office of the National Coordinator for Health Information Technology (ONC) and the Agency for Healthcare Research and Quality, (AHRQ) U.S.

Department of Health and Human Services. The goal of the HealthIT project at the U.S. Department of Health and Human Services was to foster comprehensive management of medical information and to establish security standards for exchange of information between health care consumers and providers. HealthIT project objectives included improvement of health care quality, prevention of medical errors, reduction of health care costs, increased administrative efficiencies, decreased paperwork, and expanded access to affordable care (U.S. Department of Health and Human Services, 2009).

A third rationale was to determine whether weaknesses in TR are related to the retention of health workers. For example, the American Association of Colleges of Nursing (2009) reported a nursing shortage that is expected to intensify as baby boomers age and demand for care increases. In 2009, the U.S. Congress addressed potential physician shortages through consideration of legislation titled, "Resident Physician Shortage Reduction Act" (Library of Congress, 2009). Both reports indicated national concerns regarding potential shortages of nurses and physicians, and further research is needed to determine whether or not the acceleration of HIT affects health employee retention, staffing, and early retirement.

Research Questions

The research questions for this study are based on constructs inherent in the TRI Index (Parasuraman & Colby, 2001). For example, during marketing surveys of consumers, Parasuraman and Colby found that technology beliefs of optimism and innovation contributed to an individual's positive TR, while discomfort and insecurity triggered inhibition and fears that contributed to negative technology unreadiness. This

led the authors to conclude TR was due to a combination of positive and negative beliefs and could be measured as high, medium, and low.

This study applied the TRI to the workforce of the health sector to determine if health professionals have technology beliefs and, if so, what the elements of those beliefs are. The study considered whether health professionals had combinations of positive and negative beliefs similar to the consumers studied by Parasuraman and Colby (2001), if their TR was high, medium or low, and how their TR was affected by selected variables. The research questions for this study were:

1. What is the perceived relationship between TR, as measured by the TRI, and the optimism of health professionals?

2. What is the perceived relationship between TR, as measured by the TRI, and the innovativeness of health professionals?

3. What is the perceived relationship between TR, as measured by the TRI, and discomfort of health professionals?

4. What is the perceived relationship between TR, as measured by the TRI, and insecurity of health professionals?

Results from this survey were discussed in the context of theories presented by Parasuraman and Colby (2001) regarding high, medium, and/or low TR among consumers and how consumers related to the 4 variables cited. In addition, analysis is conducted of the data obtained from health professionals to correlate their responses with categorical descriptions of TR known as explorers, pioneers, skeptics, paranoids and

laggards (Parasuraman & Colby, 2001) and with Rogers' categories of adopters known as innovators, early adopters, majority adopters, late adopters and laggards (Rogers, 1995).

Hypotheses

There are four hypothesis and null hypotheses examined by this study based on the four variables measured by the TRI including optimism, innovativeness, insecurity and discomfort. TR responses of a sample of health professionals were evaluated.

H_A1: Positive TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and optimism.

H_01: Positive TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and optimism.

H_A2: Positive TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and innovativeness.

H_02: Positive TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and innovativeness.

H_A3: Negative TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and discomfort.

H_03: Negative TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and discomfort.

H_A4 Negative TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and insecurity.

H_04 Negative TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and insecurity.

Purpose of the Study

The purpose of this study was to increase the knowledge of decision makers regarding the attitudes of health professionals towards new technologies by assessing their technology beliefs and the relationship of those beliefs to 4 variables correlated to levels of TR. This assessment classifies a sample of health professionals as high, medium and low technology adopters and describes factors that contribute to that status. Results of the research determined whether the variables studied are positive contributors or negative inhibitors to the TR characteristics of health professionals.

Knowledge gained by this research could assist with closing gaps in scientific literature regarding the TR of health professionals and their attitudes regarding use of new technologies and innovations. The use of the TRI instrument could enable researchers to evaluate how health professionals responded to and adopted new technologies and how to apply TR knowledge to the health industry. Application of the findings could assist with improving diffusion of new health information technologies into the health system. Objectives of the research in this study were to: (a) administer a quantitative survey to a sample of health professionals, (b) compile data and conduct an analysis of the results, (c) analyze findings based on theoretical constructs regarding adoption of technology and TR theories, and (d) prepare a report that contributed to the knowledge base that describes the attitudes and predisposition of health professionals towards use of new technologies.

Theoretical Framework

Theoretical framework for the study was based on Rogers' (2003) theory of diffusion of innovations; Fishbein's (1975) theory of reasoned behavior; Kuhn's (1962) theory of paradigm shifts; Davis's (1989) theory of ease of use of technology; Parasuraman and Colby's (2001) theory of TR; and Mick and Fournier's (1998) theory regarding technology and paradoxes. These and other theories presented in Chapter 2 address the process of diffusion of technologies, describe categories of technology adopters, and urge caution regarding the risks and/or rewards of successful or failed diffusion of technology into society. These researchers reiterated the significance of managing social change and technology and the importance of technology managers and policymakers in making deliberate and knowledgeable decisions regarding the impact of technology on society and individuals. Their ideas underscore the need to understand positive and negative TR among one of the largest workforces in the nation.

This study aimed to promote positive social change by increasing the knowledge of federal officials, academia, and the private sector regarding the often paradoxical elements that contribute to TR. The new constructs that emerge from this research could be used to achieve federal goals to expedite the integration of health technologies with improved targeting of incentives and training.

Definition of Terms

Health Information Technology (HIT): Comprehensive management of medical information and its secure exchange between health care consumers and providers (U.S. Department of Health and Human Services, 2009).

Health Technology: The application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives (World Health Organization, 2009).

HIT Tools: Tools include: (a) electronic medical records, (b) ePrescribing, (c) Personal Health Records, (d) Remote Monitoring, (e) Secure Messaging, and (f) Telehealth (HealthIT, 2009).

Health professionals: Individuals who are licensed and regulated include physicians, dentists, physician assistants, support staff, nurses, pharmacists, therapists, psychologists, chiropractors, physical therapists, optometrists, paramedics, and a wide variety of other individuals regulated and/or licensed to provide some type of health care. The target audience included individuals listed by the Labor Department in jobs at: (a) Hospitals, (b) Nursing and residential care facilities, (c) Offices of physicians, (d) Offices of dentists, (e) Home health care services, (f) Offices of other health practitioners, (g) Outpatient care centers. (h) Other ambulatory health care services, (i) Medical and diagnostic laboratories (U.S. Bureau Labor Statistics, 2009). Included for-profit and non-profit health providers and government officials with responsibility for health policy and administration of government health programs and services.

Technology readiness: A term developed by Parasuraman and Colby (2001) defined as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (p. 18). This construct is the basis for discussion regarding the preparation and attitude of health professionals towards the rapidly emerging innovations in health (Parasuraman & Colby, 2001).

Assumptions, Limitations, and Delimitations

A key assumption for this study was health professionals are either currently interacting with various health technologies or will be required to use them in the near future. Another assumption was the attitudes of health professionals towards new technologies in general could be generalized to understand their attitudes regarding technologies used in healthcare.

One limitation is the individuals surveyed in the study represented a number of different health professions, and their responses do not reflect the views of only one health profession, such as physicians or nurses. Based on the number of health professions included in the sample and the small number per profession, it was not possible to determine if TR varied from profession to profession. Therefore, results were interpreted to apply to health professionals in general and were not considered to apply specifically to one health vocation or professional occupation. A delimitation of the study was the sample did not include significant numbers of health professionals under the age of 25 years. The majority or respondents were over the age of 25 years.

Significance of Study

Results from this study could be useful to health managers, academic institutions, government agencies, health service providers, and decision-makers with responsibility for integrating HIT, and other technologies into healthcare. Analysis of results can provide theoretical constructs that to use in the development of education and training programs for health professionals to assist with developing positive TR and avoiding

rejection or resistance to new technologies. Table 1 lists examples of health-related occupations affected by diffusion of innovation and technologies.

Table 1

Technology Related Occupations in Health Workforce

Job Category	Job Titles
Records Management	Electronic Medical Records Managers & Administrators, Medical Informatics technicians, Electronic Dental Charts
Dentistry	Electronic Dentistry, fiber-optic cameras, lasers, teledentistry
Medicine & Nursing	Telemedicine, Teleradiology, Telepathology, Teledermatory, Telecardiology, Telestroke, Telepsychiatry, Telehome, Telenurse
Imaging	Digital Imaging Techniques, Computerized Tomography, Magnetic Resonance Imaging
Medical/Dental Surgery	Bloodless Surgery, Compute Computer assisted surgical planning, robotic surgery, augmented reality, telepresence surgery, robodoc, other robotic surgical devices, Tomography, Positron Emission Tomography,
Pharmacy/Biotechnology	Pharmacy, bioinformatics, biotechnology, Human Genome, telepharmacy
Information and Health Information Technology	Computerized medical devices, assistive technology, augmentative communications devices, computerized functional electrical stimulation, (CFES) speech recognition, Informational Resources, computer assisted instruction, health information on-line, simulation software, virtual reality, distance

Note. Table created by S. Myers, 2009, based on data from L. Burke and Weill, B, 2005, *Information Technology for the Health Professions*, Pearson and Prentice Hall and U.S. Department of Labor, 2010.

Summary and Transition

Chapter 1 included discussion of the conceptual background of the study, problem statement, purpose and nature of studying TR and key research questions. The literature review in chapter two is a literature review presented major theories regarding technology acceptance, readiness, diffusion of innovations and formation of human attitudes. Chapter 3 described methods used to conduct the TR Index Survey, reliability of the survey instrument and selection and power effect size of the sample. In chapter 4 the results of the survey are presented including presentation of the data and acceptance or rejection of the null and alternative hypothesis. Ethical considerations were also discussed in chapter 4. The last chapter—chapter 5 presented conclusions interpreted from the data, recommendations for future research and opportunities for social change.

There are concerns expressed among experts, policymakers, providers, and consumers that health technologies are critical to restructuring and transforming healthcare (Chaudry et al., 2006). If these concerns are accurate there is considerable importance for societies to understand the elements involved with acceptance or rejection of HIT considering technology is being accelerated into societies both in the United States and internationally. Recognition that HIT, and other health technologies, can transform healthcare positively and negatively can contribute to expectations of significant social changes in healthcare system in the future. However, experts caution that there may be problems with the progress of diffusing technology into healthcare and studies of hospitals report that the progress of achieving HIT goals is slow (Chaudry et al., 2006).

As one technology expert observed, "The pace of technological innovation is accelerating like never before…the rate of change is at an all-time high. What we are seeing today is innovation at the speed of life" (Bross, 2010, Retrieved from http://www.the-chiefexecutive.com/features/feature710/). If Bross's observations are applicable to healthcare then efforts to achieve acceleration at the "speed of life" could indicate a need to increase the rate of introduction of technologies into healthcare. As stated earlier, the capacity of health professionals to respond positively to new technologies is an essential element for successful diffusion of technology into healthcare. In summary, this study attempts to develop a model through application of the TRI Index to assess the TR of health professionals, with the long-term goal of assisting health professionals to respond to the challenge of doing their part to achieve the goal of a healthcare system that maximizes the use of health technologies.

Chapter Two: Literature Review

According to Parasuraman and Colby (2001), "If a techno-ready marketer desired a single revelation that would lead to spectacular success, it could well be the concept of TR" (p. 17). This statement suggested marketers who sought to promote a particular behavior, such as consumer purchase of new technologies, could be well served by understanding the concept of TR. Parasuraman and Colby's statement also applied to the health sector based on the premise that health administrators who sought to promote particular behaviors, such as adoption of new innovation and technologies, could also benefit from understanding the concept of TR. This literature review underscored the importance of understanding the concept of TR and its relevance to health professionals and the health sector.

Strategy of Literature Review

This chapter reviewed theories from a broad perspective regarding diffusion of technologies, the role of opinion leaders in diffusion, and methods for measuring and evaluating TR. Several survey instruments were considered that measured individual and organizational TR and evaluated patterns of adoption of technology. The concepts in this literature review provided a context for analyzing the TR of the sample of health professionals who participated in the survey.

A literature search of Walden University databases and academic journals did not result in a high volume of scholarly works and journal articles that addressed TR among health professionals. As an alternative, a multidisciplinary approach was used to explore literature in computer science, business, anthropology, psychology, communications,

marketing, human relations, social science, health, nursing and medicine. This approach provided a range of perspectives about individual responses to attitude formation, paradoxical behaviors, TR, paradigm shifts, and diffusion of innovations, technology initiatives and human behaviors, beliefs and societal factors. Key words used to search Walden databases included technology readiness, health professionals and technology readiness, attitude formation and health professionals.

Summary and Synthesis of Ideas

There are a number of ideas regarding TR and adoption of technologies that can be discussed in the context of TR. Relevant themes include attitudes, beliefs and TR readiness, responses and issues regarding diffusion of innovations, and the concepts and tools that can measure TR. Attitude formation and characteristics of adopters are intrinsic components of TR (Rogers 2003). There are also measurable traits of TR among individuals that serve as indicators regarding how they adopt innovations and their rate and methods of adoption (Rogers 2003). Fishbein and Ajzen (1975) described readiness as a mental state or attitude tied to predispositions toward new situations or innovations. They emphasized how positive or negative past experiences impacted how individuals learned and how they accepted or rejected innovations.

Parasuraman and Colby (2001) discussed the importance of beliefs regarding TR and how experiences contributed to beliefs, predispositions and antecedents of attitude formation. While the term TR was not used by Fishbein and Ajzen (1975), both pairs of scholars reinforced the concept that TR was an attitude, belief, or predisposition (Fishbein & Ajzen 1975; Parasuraman & Colby, 2001). Parasuraman and Colby (2001)

presented four attitudes, termed "domains," of TR that included optimism and innovativeness defined as "contributors" that increased an individual's TR; and discomfort and insecurity defined as "inhibitors" that suppressed TR (pp. 33-34). These four domains were the variables in this study.

Mick and Fournier (1998) discussed the idea that daily attitudes and beliefs towards innovation were modified by paradoxical attitudes and beliefs. They examined paradoxes in which individuals experienced simultaneously conflicting positive and negative feelings towards technology. Attitudes of apprehension regarding technology acceptance were discussed by Barnhart and Ratchford (2007), who found skepticism among individuals when they were uncomfortable or suspicious regarding the capacity of certain technologies to perform properly.

Rogers's (2003) theories provided a context for considering TR among health professionals by providing elements that classified individuals into categories of early and late adopters. Parasuraman and Colby (2001) described characteristics of technology adopters in terms of high, medium and low, and while the categories of characteristics were not exactly the same as Rogers's (2003), they were similar. Rogers (2003) described influential opinion leaders as individuals identified by socioeconomic status, mobility, access to current information and the ability to influence others. The concept of opinion leaders and risk takers and their roles in diffusion of technologies were significant concepts for health professionals in occupations with attributes of mobility, status, and influence.

The personal innovativeness in information technology theory (PITT) by Agarwal and Prasad (1998) described risk takers as individuals with high intentions in innovativeness towards new technologies. Agarwal and Prasad presented a category of technology adopters that could be very important to health institutions seeking to assist health professionals to adopt new technologies. Their theoretical concepts suggested that risk takers could be identified and would be the first to adopt innovations (Agarwal & Prasad, 1998).

Like Rogers (2003), Parasuraman and Colby (2001) described adopter categories and outlined the characteristics of the various categories (p. 60). The groups identified by both sets of scholars were similar however, Barker (2004) added a hard-to-recognize group of hidden leaders who were difficult to detect and did not fit into categories described by Rogers (2003) or Parasuraman and Colby (2001). The hidden leaders observed by Barker (2004) were unseen parts of the culture of societies but did not necessarily meet the criteria outlined by Parasuraman and Colby (2001) and Rogers (2003). The hidden or subtle leaders identified by Barker (2004) were often opinion leaders who supported or blocked new ideas presented to their societies.

Diffusion of Innovations

Diffusion of innovations was a second theme addressed in the literature review. This discussion included observations about the roles of opinion leaders and change agents and how they participated in the process to diffuse innovations throughout societies. Key opinion leaders and change agents had the capacity to persuade and influence individuals within their professions as well as individuals who were not their

peers (Parasuraman & Colby 2001, Rogers 2003). Opinion leaders were described as informal leaders who gained authority by their personal competence and ability to either adopt or resist change and innovation. The importance of these opinion leaders and change agents was underscored by Rogers (2003) because they could either be leaders in diffusion of innovations or serve to block innovations. This discussion is relevant because many health professionals are opinion leaders and are therefore influential in the health system and other segments of society.

Spicer (1952) discussed how individuals perceived change and while he did not use the term attitude used by Fishbein and Ajzen (1975), he referred repeatedly to behavior and culture in a manner that was similar to Fishbein and Ajzen's description of how attitudes affect behaviors. Spicer discussed how individuals perceived changes that were introduced into their cultures and the positive and negative effects of change. Spicer (1952) expressed scholarly concern about how innovations diffused into society could damage cultures and societies, particularly if during the introductory period the changes were managed badly during the introductory phase. A decade later, Kuhn (1962) reinforced Spicer's concerns by asserting that knowledge introduced to societies inappropriately could result in damages as extreme as scientific and/or societal revolutions. Such extremes could occur when the norms of a society shifted and knowledge changed resulting in paradigm shifts or institutional gaps, described by Kuhn as lack of fit (Kuhn, 1962).

Spicer and Kuhn's concerns were relevant during periods when rapid diffusion of innovations and technologies were introduced to populations that were not prepared or

ready to absorb them. Poor introduction of these technologies resulted in lack of fit and there were significant negative outcomes (Spicer, 1952). When negative outcomes occurred, Kuhn suggested that discrepancies could be resolved if sufficient time and attention were paid to assisting societies to alter and adjust to change (Kuhn, 1962). However, if organizations or societies did not apply sufficient time, attention, and resources discrepancies could increase and societal crisis could result, perhaps even causing breakdowns in the societal structures (Kuhn, 1962). Such possibilities should serve as areas of concern for health administrators and managers who are responsible for managing introduction of new technologies into the health care sector. Kuhn (1962) and Spicer's (1952) warnings should be viewed as potential unintended societal outcomes that could result from badly managed introduction of new innovations.

A third theme included in the literature review discussed tools and methods used to measure dimensions of technology adoption and TR. Examination of the elements of the TRI survey developed by Parasuraman and Colby (2001) were considered, as well as TR concepts presented by Venkatesh and Bala (2008) and Davis (1989) that supported Parasuraman and Colby's TRI instrument as a conceptual and practical approach to measure predispositions and attitudes of consumers towards technology (2001).

Ease of use and technology acceptance variables were other elements used to measure and interpret TR, based on research by Davis (1989). His theory provided the conceptual basis for the technology acceptance model (TAM) produced by Davis and Bagozzi (1992) in which they found that ease of use was a significant factor in

technology acceptance. The TAM is also a tool that measures TR, thereby further validating the concept of TR.

Agarwal and Prasad (1998) developed a construct that identified individuals as personal innovators in the variable of information technology known as PITT. The concept of personal innovators added to the discussion regarding TR by identifying a category of individuals beyond the categories provided by Parasuraman and Colby (2001) and Rogers (2003). In addition, Venkatesh and Bala (2008) found TR issues among employees at companies where they had technology concerns regarding perceived usefulness, job relevance, output equality, results, and perceived ease of use. They found that when factors of usefulness and ease of use were not present employees would not engage the technology and IT investments could be wasted (Venkatesh & Bala, 2008). These findings could be relevant to health professionals in workforce setting who place a priority on ease of use and perceived usefulness. The following section provides more details regarding theories and concepts.

Comparison and Contrast of Technology Readiness Theories

This section provides a more extensive review of books and journal articles regarding attitude formation, belief systems, TR concepts, societal paradigms and societal dynamics inherent in adoption of innovations and new technologies. The theories in the review are organized in the three themes of: Attitudes, Beliefs and Readiness; Responses and Issues Regarding Diffusion of Innovations; and Concepts and Tools to Measure TR. Comparisons and contrasts of theories of scholars are presented to identify major areas

of agreement and areas of differences. Included are concepts that apply to the study of TR of health professionals in general and relevance to the sample studied.

The first section on attitudes, beliefs and readiness included Fishbein and Ajzen (1975), Parasuraman and Colby (2001), Mick and Fournier (1998), and Barker (2004). The second part on responses and issues regarding diffusion of new technologies included Rogers (2003), Spicer (1952), Wejnert (2002), Barnhart and Ratchfort (2007), Venkatesh and Bala (2008), Parasuraman (2000), Parasuraman and Colby (2001), Thomas Kuhn (1962), Agarwal and Prasad (1998), and Barker (2004). The third and final section reviewed concepts and tools that measured technology measurement including Parasuraman and Colby (2001), Venkatesh and Bala (2008), Davis (1989), DeSantis and Poole (1994), Brown and Venkatesh (2005), Snyder and Fields (2006), Barnhart and Ratchford (2007), and Caison, Bulman, Pai & Nevelle (2008).

Attitudes, Beliefs and Readiness

Fishbein and Ajzen (1975) described how attitudes were formed by asserting that understanding human behaviors required separate evaluation of four key variables including: (1) beliefs, (2) attitudes, (3) intentions, and (4) behaviors (p. 10). Fishbein and Ajzen suggested readiness was a mental state or attitude and was, therefore tied to predispositions toward new situations or innovations. They stressed the importance of experiences to formation of attitudes as well as belief systems, knowledge, and intention. Fishbein and Ajzen (1975) emphasized that positive or negative past experiences affected how individuals learned and contributed to how they accepted or rejected innovations.

Fishbein and Ajzen (1975) emphasized that positive or negative past experiences affected how individuals learned and contributed to how they accepted or rejected innovations. The theory of reasoned behavior (Ajzen & Fishbein 1975) suggested that separate analysis of beliefs, attitudes, intentions, and behaviors were essential to evaluate attitude formation, change, and resulting behaviors. The authors observed, "Attitude is probably the most distinctive and indispensable concept in contemporary American social psychology" (Fishbein & Ajzen, 1975, p. v) They indicated that attitude was a general feeling of "favorableness or unfavorableness towards some stimulus objects" (Fishbein & Ajzen, 1975 p. 216). One key element presented by Fishbein and Ajzen was "cognition" defined as "knowledge about behavioral intentions, opinions, beliefs, and thoughts," and another element was "conation" which defined behavioral intentions (Fishbein & Ajzen, 1975, p. 12). Another element was "behavior or observed overt acts" (p. 12). They found that past events, beliefs and experiences all affected the elements that formed attitudes that led to behaviors.

Fishbein and Ajzen believed favorable and unfavorable behaviors and favorable and unfavorable responses consistently provided knowledge of attitudes. When those attitudes were understood, then behaviors could be predicted in one or more ways, and when an individual's predisposition was established, it was expected they would or would not perform the behavior in question (Fishbein & Ajzen 1975, p. 9). Fishbein and Ajzen (1975) asserted that contributors to predispositions and attitudes were measured in multiple ways and one method of determining the attitudes was through single question interviews and surveys that measured likes and dislikes.

Table 2

Contributors to Attitude Formation

Past Experiences	Beliefs	Feelings	Heritage	Peer Influences
Intentions	Anxieties	Religion	Work Experiences	Family Teachings
Knowledge	Customs	Education	Ethnicity	

Note: Developed by S. Myers, 2009, based on Fishbein and Ajzen, 1975

This study used the survey method to determine attitudes recommended by Fishbein and Ajzen (1975) instead of other methods they proposed such as evaluation of psychological and non-verbal behaviors through use of biofeedback tools that measured galvanic skin responses, eye movements, sweating, etc. Those approaches were combined, evaluated, and statistically weighted in sums, averages, different scoring, and ratios (1975). While Fishbein and Ajzen believed it was possible to investigate key variables of beliefs, attitudes, intentions, and behaviors using innovative approaches such as biofeedback, they also warned those approaches could be challenged by skeptics.

Fishbein and Ajzen's (1975) research applied to the predictability of attitude formation in general and not just attitudes regarding TR. In contrast, Mick and Fournier (1998) analyzed attitudes towards technology and determined there were conflicting attitudes about technology that could co-exist simultaneously. This paradoxical attitude may not apply to all situations but, Mick and Fournier (1998) determined there were technology paradoxes that described attraction and avoidance responses to technology at

the same time. They concluded there were significant apprehensions and concerns about technology and ownership of technological products that fostered complex and conflicting feelings in individuals-- sometimes resulting in negative reactions to innovations.

The eight paradoxes that Mick and Fournier (1998) described as simultaneous attitudes and beliefs were: (a) Control/Chaos: Technology can facilitate regulation or order, and technology can lead to upheaval or disorder; (b) Freedom/enslavement: Technology can facilitate independence or fewer restrictions, and technology can lead to dependence or more restrictions; (c) New/obsolete: New technologies provide the user with the most recently developed benefits of scientific knowledge or new technologies that are already or soon to be outmoded as they reach the marketplace; (d) Competence/incompetence: Technology can facilitate feelings of intelligence or efficacy and technology can lead to feelings of ignorance or ineptitude; (e) Efficiency/inefficiency: Technology can facilitate less effort or time spent in certain activities and technology can lead to more effort or time in other activities; (f) Fulfills/creates needs: Technology can facilitate the fulfillment of needs and technology can create new needs; (g) Assimilation/isolation: Technology can facilitate human togetherness and technology can lead to human separation; (h)Engaging/disengaging: Technology can facilitate involvement, flow or activity and technology can lead to disconnection, disruption or passivity.

Mick and Fournier (1998) provided examples that could apply to health professionals that showed how potential users/consumers reacted with conflicting

emotions regarding technological household and office products and found there was tension between fulfilling needs and creating new needs by new technologies that were felt by users in various ways and at various times. Consumers and users of technology used a range of strategic behaviors to cope with the technology paradoxes identified by Mick and Fournier, ranging from "avoidance of technology; delays of use of new technologies; becoming acquainted with new technologies through other individuals; making extra efforts to understand and use technologies through partnering; and thoroughly learning new technology operations, strengths and weaknesses" (Mick & Fournier 1998, p.140). They also determined that coping mechanisms were moderated by product, situation, and person factors over time and that mediators and moderators affected coping strategies (Mick & Fournier, 1998). Based on analysis by Mick and Fournier, individuals were acutely aware of the presence of technology in their lives but, did not automatically accept technologies as ubiquitous and essential to their lives (p. 140). They also found that individuals were aware of the need to cope with technologies in their homes and in the workplace.

In the health sector, paradoxes could occur when health professionals used technologies in their daily lives but, had simultaneous concerns and fears about medical and health technologies. For example, health professionals who were confident regarding using computers for personal banking could be uncomfortable regarding patient confidentiality when asked to use electronic medical records. Alternatively, technologies that produced efficiencies for one type of health organization with staff proficient in

computing could simultaneously produce inefficiencies for other organizations with fewer skilled staff.

Mick and Fournier (1998) recognized that paradoxes in TR contributed to the complexity of adoption of technology and diffusion of technology in societies. These theories of paradoxes provide a context for analysis of the responses of health professionals in this study who are required to adopt new technologies in the health sector but, may feel uncomfortable with new technological products. The TRI assessment conduced in this study will determine if the paradoxes cited by Mick and Fournier (1998) applied to the sample of health professionals.

Another approach to analysis of attitudes was the theory of perceived usefulness and ease of use developed by Davis (1989). Davis's theory was an extension of Fishbein and Ajzen's (1975) theory of reasoned behavior through validated measurement scales that identified determinants regarding user acceptance of technology from an information systems perspective, rather than a behavioral science perspective. Davis found those scales to be successful in measuring usage behavior and relationship of expectancy, self-efficacy, behavioral decision-making, diffusion of innovations, marketing and human computer interaction.

The original constructs used in Davis's (1989) research identified usefulness and perceived ease of use. One of the most significant findings was the relationship between usefulness and usage compared to ease of use and usage. Davis found that usefulness was more important to users than ease of use. Stated differently, if individuals found

technology to be useful for their work, they were more willing to adopt it, even if it was difficult to use (1989).

Issues Regarding Diffusion of Innovations

In the book, *Diffusion of Innovations* Everett Rogers discussed the role opinion leaders performed in the adoption of new ideas (Rogers 2003). He indicated that new ideas were adopted by social units or social systems where leaders performed key roles in introducing new ideas. Rogers stressed the importance of understanding how to overcome the barriers of getting new ideas adopted and how the absence of local input can delay adoption of innovations (Rogers 2003). He asserted that authority figures, followers, and change agents promoted change through spontaneous or the planned spread of new ideas. Rogers views are summarized in his observation, "Getting a new idea adopted, even when it has obvious advantages, is difficult" (Rogers, 2003, p. 1).

Rogers diffusion theory is defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system…a special type of communication in which the messages are about a new idea" (Rogers, 2003, pp. 5-6). Essentially, diffusion theory is how and when new ideas are either adopted or rejected, and how rapidly they are spread through society. The theory of diffusion of innovation in adoption of technology includes four main elements that apply to social systems, organizations, or individuals including: (1) innovation, (2) communication, (3) time, and (4) social systems. Rodger's described the 4 elements as a "system or process of diffusion by which (1) an innovation (2) is communicated through

certain channels (3) over time (4) among the members of a social system" (Rogers, 2003, p. 11).

There are a number of key elements in Rodger's (2003) diffusion theory beginning with an idea and its perceived desirability or undesirability followed by the idea being communicated by the media, interpersonal channels, or other vehicles (Rogers, 2003). Next, he determined there was a time element required for the idea to move around to key opinion leaders and finally the idea would be accepted by a social structure, leaders or society (Rogers, 2003). For the purpose of this study, the "ideas" are the health technologies that are being diffused into the health sector. The three main types of innovation decisions are: (1) optional innovation decisions, where individuals made a decision to adopt or reject a new idea independent of others members of their social system, (2) collective innovation decisions where consensus was reached among members of a social system to adopt or reject an innovation or new idea, and (3) authority innovation decisions where individuals with power, status or technical expertise decided to adopt or reject an idea or innovation (Rogers, 2003). Rogers also included a fourth category, "contingent innovation-decisions" where choices to adopt or reject were reconsidered after an initial decision to not adopt. Whether or not an idea is adopted at a fast or slow rate in a particular group is contingent upon decision-innovation options and the outcome of each option results in consequences for individuals, units, or social system (Rogers, 2003, p. 38).

There are four key elements in the diffusion of innovations. First, there is innovation--an idea or practice that is new to an individual or organization. There may be

favorable or unfavorable responses to the innovative idea and the desirability of the idea is based on the relative advantage to the group, its compatibility, complexity, trialability, and observability. The second key element in diffusing new ideas is the role of mass media and how effective it is in communication of knowledge about new ideas. Interpersonal peer channels are influential in this the role of media and whether or not individuals accept of reject new ideas. Other significant factors are the qualities between two or more individuals and how they respond to the communications about the new idea.

The third element identified by Rogers (2003) was time--a key part of the innovation decision process because of the time it takes for a new idea to come to an individual or other unit. It also takes time for knowledge to convey from one person to another, time for decisions to be made to either adopt or reject new ideas, and time to implement and confirm decisions about the innovation. Finally, social systems are important and the structure of those systems can facilitate or impede diffusions of innovations. Rogers (2003) noted various types of opinion leaders and change agents operated in social structures where they influenced the attitudes of others. The professional change agentswere focused on producing desired outcomes and tried to influence client behavior, but may not have been as successful as their peers in the social structure (Rogers, 2003).

Rogers (2003) made the observation "individuals in a social system do not all adopt an innovation at the same time" (p. 267). He classified individuals in "adopter categories" based on when they first began using an idea and identified five adopter

categories called “ideal types” based on “abstractions from empirical investigations” (Rogers, 2003, p. 282). Based on Rogers’ analysis, it should be possible to understand the ideal types among health professionals and to design approaches for each type in order to establish frameworks that increase knowledge regarding TR.

While exceptions could be found in ideal type classifications, Rogers defined five categories that described how individuals respond to innovation. His first category was termed innovators who were venturesome almost to the point of obsession. These innovators were not be connected to local professional groups and were cosmopolites who understood complex technologies and could cope with uncertainty. The next category were early adopters who were integrated in local social systems, had high degrees of opinion leadership, and advised others about suitability of ideas. Early adopters served as change agents and role models in their social systems and could trigger critical mass when they adopted innovations. The early adopters were respected by their peers and maintained high esteem due to their judicious decisions regarding innovations.

The third category known as the Early Majority adopted ideas just before the mainstream of society. They did not hold opinion leadership and served as important links for interconnectedness in interpersonal networks. Rogers (2003) indicated that one third of society could be found in this category and this group tended to deliberate longer than innovators or early adopters. The early majority were good followers but not leaders.

The fourth category known as the Majority would be skeptical and would adopt new ideas just after the majority of people. This group would adopt ideas in response to

peer and economic pressures and would be skeptical even after others have accepted the ideas. The weight of social norms would have to be in favor of the innovation for the Majority to adopt it with access to sufficient resources. The final category was the Laggards—a group of individuals who were the very last to adopt an innovation with very little opinion leadership. Laggards were usually localities and isolated in their social systems. They tended to be suspicious of change agents and innovation and lagged far behind in awareness of new ideas often due to scare economic conditions. This gap or lag in awareness could be due to socioeconomic status, societal values, and lack of communication (Rogers, 2003).

The definitions presented by Rogers (2003) were significant when determining how to prepare individuals and communities for new ideas in the form of technologies and innovations. Rogers believed ideas and innovations were diffused by organizations and social systems through opinion leaders and change agents with defined roles who supported or blocked adoption of the new ideas (Rogers, 2003). He observed that innovators who were the most technologically ready were often not connected to social networks but, early adopters and early majority were. He indicated that opinion leaders functioned in "diffusion networks" that were systems of communications and dictated "the degree to which an individual is able informally to influence other individuals' attitudes or overt behavior in a desired way with relative frequency" (Rogers, p.300).

There were many characteristics cited by Rogers (2003) that were important to comprehend in order to understand how ideas spread through cultures. Opinion leadership was a significant category in diffusion theory where opinion leaders had

access to external communications and as a result of travel had access to mass media, exposure to change agents and interfaced with different groups of professionals. The opinion leaders were accessible to interpersonal networks where they participated socially and had higher economic status than did followers. Opinion leaders would generally adopt new ideas before followers and were innovative even if they were not innovators. The opinion leaders would reflect the norms of their social systems and would be part of organizations used to diffuse innovations (Rogers, 2003).

The characteristics for opinion leaders were relevant to health professionals who incorporated the characteristics of well-traveled cosmopolites with exposure to mass media and access to external communications. Opinion leaders qualified as individuals who were part of networks that could diffuse innovations and ideas rapidly. Rogers (2003) diffusion theory should have significant application to diffusion of new health technologies among traditional health professional groups and new and emerging technology-related health occupations.

An S-shaped diffusion curve was determined by Rogers (2003) to illustrate how opinion leaders could quickly disseminate information because "once opinion leaders began telling others about an innovation, the number of adopters per unit of time expanded in an exponential curve" (Rogers, 2003, p. 300). Rogers (2003) described the role that incentives and subsidies could play in "speeding up the rate of adoption of innovations" (pp. 236- 237). The incentives he referred to were provided as cash payments and as in-kind contributions to encourage faster adoption rates of innovations. Rogers reached three conclusions regarding the impact of incentives on adoption of

innovation: (a) incentives increased the rate of adoption of an innovation; (b) adopter incentives lead to adoption of innovations by individuals different from those who would otherwise adopt; and (3) although incentives increased the quantity of adopters of an innovation, the quality of such adoption decisions may be relatively low, thus limiting the intended consequences of adoption (Rogers, 2003, pp. 238-239).

In the Personal Innovativeness in the Adoption of Technology Model, (PIIT) Agarwal and Prasad (1998) focused on personal innovativeness in the adoption of technology. They determined there were measurable characteristics among individuals that indicated who might be predisposed to accept innovations and new technologies and might reject said innovations (Agarwal & Prasad, 1998). PITT was based on constructs drawn from the Technology Acceptance Model by Fred Davis (1989); Technology Acceptance Model 3 (Venkatesh & Brown, 2008); Everett Rodger's diffusion of innovation theories (Rogers, 2005), and Fishbein and Ajzen's (1975) theory of reasoned behavior.

The PIIT measured attributes among individuals who were willing to accept risks, cosmopolites who are well-traveled and well-read, change agents and opinion leaders. It served to identify those individuals who were early adopters and could be a useful instrument as a follow-up to the TRI. Individuals high in PIIT were defined as: (a) risk takers who could manage uncertainty and imprecision; (b) individuals with positive perceptions about innovations; and (c) individuals with high intentions toward using new innovations and technology (Agarwal & Prasad, 1998). They found that PIIT moderated the way information was interpreted by individuals and epitomized risk taking propensities

resulting in individuals high in PIIT being willing to take risks with innovations while others with access to the same information but, a lower PIIT might avoid taking those same risks. The PITT was used to identify factors that could be considered in the hiring process of health professionals who would be expected to lead implementation of diffusion of health technology initiatives. Having such a tool that could differentiate among early and late adopters of technology could result in considerable savings and efficiencies.

Understanding PIIT is useful when an entity is attempting to diffuse innovation or technology among particular segments of society and this could apply to health professionals. If change agents in a group of health professionals were identified early then individuals with a high level of PIIT could be targeted and utilized to diffuse the desired new technologies more rapidly. The views of Agarwal and Prasad (1998) have significant implications regarding the diffusion of technology among health professionals. For example, if personal attributes of health professionals can be measured in advance to determine high levels of positive TR and high levels of PIIT then change agents among health professionals can be identified and used to diffuse new ideas, HIT or innovations thereby, advancing the introduction of new health technologies. Agarwal and Prasad also believed that individuals with PITT absorbed information and disseminated it faster than individuals who relied on relative advantages, ease of use or compatibility with technology

The term TR "TR" (Parasuraman & Colby, 2001) described individual beliefs and behaviors that transpired when new technologies were introduced in the workplace, school, or home. TR referred to the decision-making process that individuals engaged in regarding use of technology that was unique and different from the decision process used

for non-technology decisions. The TR theory is relevant to understanding the decision-making process of individuals—including health professionals, who are confronted with responding positively or negatively to new technologies.

There are three elements that Parasuraman and Colby (2001) believed determined an individual's attitude towards new technologies (TR).They believed TR varied from individual to individual and that individual's could use technology but, their method of adoption would depend on their nature and personality. They also believed TR was multifaceted and a blend of different beliefs, customs and culture. TR was more than just the tendency to be an innovator or early adoptor—it described a person referred to by Rogers (2003) as venturesome (Parasuraman & Colby 2001). TR could also predict consumer behavior, the adoption rate of new technologies and explain the manner in which the technology was used, including association of a degree of satisfaction with technology and the kind of support required (Parasuraman & Colby, 2001).

In 1962, Cornell University sponsored an evaluation of the social and cultural dynamics that occurred when innovations and technologies were introduced to areas deficient in those technologies. Results of the case studies were summarized in the book, "Human Problems in Technological Change" (Spicer, 1952). According to Spicer (1952), the process of introducing new ways of thinking to target audiences was difficult and often failed. Spicer believed that the introduction of unknown technologies to a society could have far-reaching impact. He noted, "When an administrator of a technological change program alters a people's way of life, he is not just dealing with one individual but, with the well being and happiness of generations of men and women"

(Spicer, 1952, p. 13). Spicer made those comments after observing diverse groups of people respond to introduction of methods they were unfamiliar with in agriculture, health, industry, and medicine.

The situations Spicer observed ranged from the introduction of hybrid corn to Mexican farmers in New Mexico; introduction of steel axes to Aborigines in Australians and encouraging Japanese to pick cotton in World War II relocation centers. Spicer observed how the innovations and technologies were introduced to the societies, where they were rejected or adopted, and how they positively and/or negatively affected the societies.

From his observations, Spicer (1952) concluded that if the skills of persons who introduced innovations to a culture were poor, they could destroy the cooperative human relations in the culture and create hatreds that could harm numerous people. Conversely, he noted that if the skills of the external parties introducing innovations were good, they could improve cultures and better the lives of generations. He cited examples where external parties called "technology administrators" introduced new ways of doing things into villages and native groups responded sometimes positively and other times negatively (p. 13-14). Spicer warned that technology administrators have a responsibility to be careful and that training should be the basis for each judgment.

According to Spicer (1952), the desire of one culture to export new ways of doing things or innovations and technology to another culture was a result of the intellectual practice of specialization fostered by the industrial revolution during the early 1900s when specializations emerged in medicine, tools, manufacturing, agriculture,

transportation and inventions and discoveries in science. He acknowledged that in contemporary society, individuals and agencies could mobilize significant resources to improve societies through agricultural practices, health systems, environmental conditions, and/or the performance of industry. Those activities could be large on a societal level or small interventions within villages and/or communities.

In 1952, Spicer felt that specializations were entering society at "break-neck speed" (p. 14). However, although some cultures specialized, produced, and diffused innovations those innovations were not spread at the same rate to all societies—even though the societies could perhaps benefit from them. The rate of acceptance of new ways of doing things or diffusion of innovation and technology were affected by varied levels of education, knowledge, readiness, and acceptance. According to Spicer, specialists, inventors, or technology administrators with the benefit of college education or training were exposed to the same educational environment of their societies-at-large thereby enabling the innovations and technologies to be diffused easily. However, when a specialist, inventor, or technology administrator attempted to spread innovations and new technologies from a culture that was different from the culture he/she was trying to affect -- problems could emerge. "It is this throwing together of two different cultural backgrounds that gives rise to the special group of problems that confront workers" (Spicer, 1952, p. 15). He concluded that programs dedicated to "bettering" societies often had the unintended consequence of creating instability in those societies.

In a discussion, termed "Fabric of Human Culture" Spicer (1952), contrasted specialists who compartmentalized knowledge with people in other cultures who viewed

their experiences as motivated by God, religion or spiritualism. In other words, what one culture may have viewed as the outcome of a chemical or biological experiment may be perceived by another culture as magic. To remedy the differences and perceptual gaps, Spicer (1952) proposed that workers could consciously cross barriers of language, beliefs, and understandings. Spicer refuted notions that people resisted change with his observations that people constantly change their ways and their way of life and he cited dramatic changes that have occurred among many cultures, although the rate of change may have varied from culture to culture. In Spicer's view, resistance to change was a symptom of something that had gone wrong in the cross-cultural dynamics.

Spicer (1952) asserted that once resistance ceased to be perceived as a permanent state and instead was seen as a special condition or symptom it was then possible for those who were seeking to introduce innovation or change in society to discover the causes of success or failure of introducing that change. Although Spicer's observations in the 1950's were based on agricultural, health and sanitation examples rather than contemporary examples of computers, broadband or networking, his observations are relevant to the issue of change in the health sector brought about by innovation. New ways of doing things may be perceived as advanced forms of change by the communities being affected--regardless of time or location. In his analysis, Spicer summarized the course of events involved with introducing innovations and the outcomes of whether or not the technologies succeeded or failed.

There are several elements Spicer outlined (1952) that must be understood when introducing innovations to societies including: (1) Customs are linked together, (2) how a

change in one may affect many others, and (3) how one well-established custom may prevent or retard change in another custom. These elements were based on the idea that people think and act in patterns of behavior that are learned from childhood, make sense to them, and are perceived as right and proper. Spicer's concepts of introducing innovation to society can be applied to various societal sectors. Listed in Figure 1 are 3 elements identified by Spicer (1952) to consider when introducing innovations:

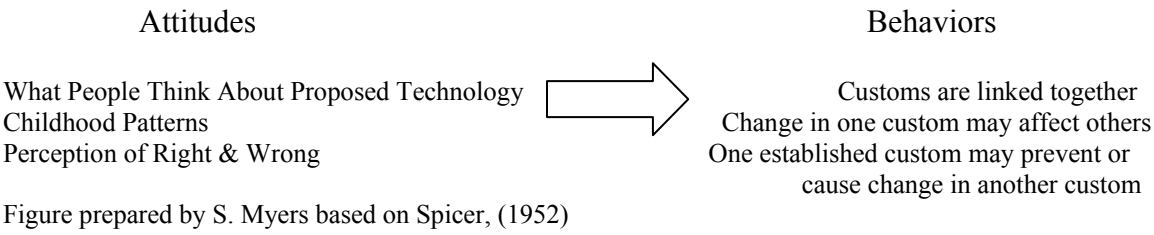

Figure 1. Three Elements to Consider When Introducing Innovations

According to Spicer, individuals and groups adapted and learned to behave in different ways if the approach was correct (Spicer, 1952). Four concepts Spicer proposed for guiding cultural change were: (1) appraising the situation, (2) planning steps to initiate change, (3) getting at the causes of success, (4) getting at the causes of failure (p. 292). He asserted people do not vary their behaviors unless they feel there is a compelling need that is not being satisfied by existing practices. When the need was identified and agreed upon, changes could follow three (Spicer, 1952).

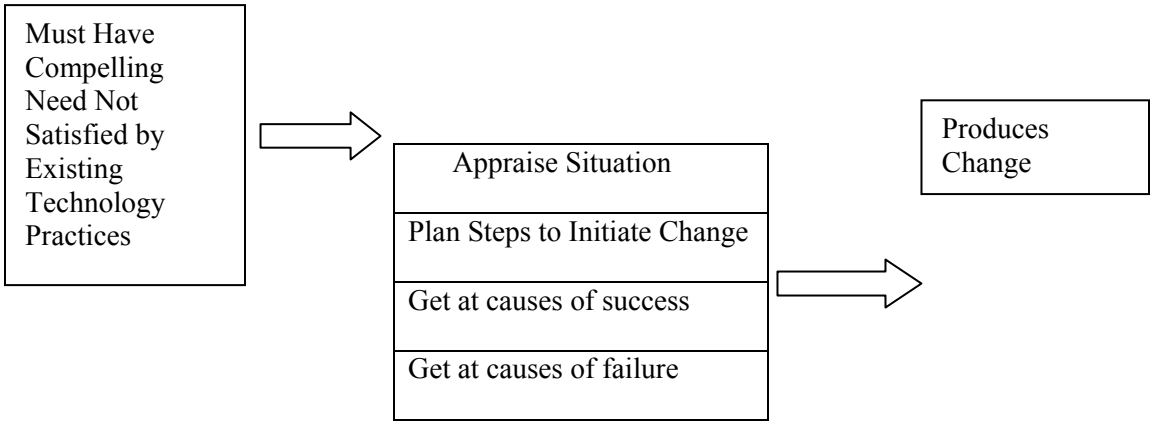

Figure prepared by S. Myers based on Spicer (1952)

Figure 2. Three Steps to Guide Cultural Change

In her research, Wejnert (2002) found that there were consequences when technologies were introduced without adequate planning. Wejnert observed that there was insufficient research that cross-connected information and analyzed the impact of innovation on interactions among professionals, organizations and governments (Wejnert, 2002). In addition to the public and private impact of innovations, Wejnert expressed concerns that diffusion of innovations could affect societies and governments and result in historic transformations. She indicated that little regard was provided to conducting costs benefit analysis regarding the impact of introducing innovations to the public sector. Her concerns are relevant to the planning process of the introduction of health technologies into the public and private health sectors.

Wejnert suggested there was difference between diffusing innovations to the private sector and diffusing those same innovations to the public sector. An innovation in

corporate or private setting could be controlled and targeted to meet specific organizational goals such as productivity or employee communications. However, when innovations were spread to society and new ideas or tools were spread throughout the society, new philosophies or ways of thinking could change entire cultures (Wejnert, 2002). To respond to Wejnert's concerns there is a need for an emerging research capacity that can analyze the impact of diffusion of technologies on society and make comparative analysis among professionals. This type of analysis would also be relevant to the healthcare sector and the diffusion of technology.

Thomas S. Kuhn (1962), author of *The Structure of Scientific Revolutions* observed, "New and unsuspected phenomenon is repeatedly uncovered by scientific research" (p. 52). His comments applied to new and unsuspected technologies and innovations uncovered by inventors, scientists, and technologists. Kuhn's observations described examples of discoveries in science that occurred under existing paradigms and when anomalies existed-- new discoveries were prompted. His comments were applicable to industries such as the health sector where innovations and technology applications were regularly discovered under known paradigms and often prompted innovations thus, leading to the phenomenon Kuhn described as *paradigm shift* (1962).

Kuhn (1975) defined a paradigm as a constellation of beliefs, values, and techniques shared by a given community and he noted that when one element was fundamentally changed it changed the entire paradigm or belief changes. Shared paradigms were described by Kuhn as "committed to the same rules and standards for scientific practice" (p. 11). Therefore, paradigms are puzzles or problems that are best

understood if there is a common language and understanding among the participants who may be scientists, or in the case of this research--health professionals. Although Kuhn's (1975) references to paradigms are within the context of science, his concepts can be used to describe societal paradigms or puzzles that apply to the health sector where health professionals are interacting with a common understanding of rules and standards that would be modified upon introduction of new health technologies.

Kuhn (1962) observed that anomalies are hard to recognize and adjust to, and in-science innovations or novelties emerge only after strong resistance from individuals or institutions who are accustomed to acts and objects following a certain set of rules. When rules changed and paradigms shifted, Kuhn warned that something had changed and modifications in conceptual categories were required until the new discoveries or anomalies were accepted (1962). According to Kuhn, the process of having a set of rules govern a process or object and then having the rules change could lead to crisis in a society and new scientific (or technological) theories, novelties and innovations would emerge. Kuhn went so far as to suggest that crisis was a necessary precondition for the emergence of novel theories (p. 77).

The emergence of novel theories or paradigm shifts is what social scientists refer to as change. If crisis is a precondition for change then paradigm shifts could be problematic for societies or elements of society undergoing rapid change such as in the United States where the health system is adjusting to the rapid introduction of HIT, and other innovations. It is not possible to know what impact the introduction of technology

will have on society or on health professionals who are accustomed to a set of rules different than rules required by innovations.

Kuhn (1962) warned that "lack of fit" of a new anomaly (or problem) in a paradigm could become a subject unto itself, resulting in resistance and increased attention that could alter and ultimately resolve discrepancies. He outlined three steps in a paradigm shift crisis: (1) Blurring of the paradigm; (2) Loosening of rules regarding existing paradigms; (3) Conducting research but, in a narrower scope—to make room for the emerging data. Kuhn asserted that sometimes the rules of an existing paradigm can handle the crisis provoking problem despite the despair of those who see the end of an existing paradigm (end of an era). In other instances, the problem of a paradigm shift is not easily solved and is set-aside for the future (Kuhn, pp. 84-85).

In instances when new discoveries or innovations emerge, there is a battle for acceptance of any new paradigms that emerge. Kuhn (1962) observed that new paradigms are not cumulative, but are reconstruction of the existing field from new fundamentals. Old problems solved by old solutions gave way to decisive differences in the new modes of solution resulting in paradigm shifts where entire fields changed, including methods, goals, and perceptions.

When old paradigms shifted to the new, there could be periods when there was no institutional governance and old rules did not apply (Kuhn, 1962). As a result, societal segments could polarize and a crisis could deepen when proponents of the old, accepted science or practice continued to defend the old ways and were committed to concrete positions. At this point, the scientific community (or society) could become divided with

some defending old practices and others seeking new paradigms or definitions that fit the new realities.

When polarization occurred in society, recourse could fail and those pushing for change could resort to mass persuasion techniques or even force (Kuhn, 1962). To apply Kuhn's (1962) theories to the introduction of HIT would suggest that the changes brought about by the introduction of paradigm shifts could work if there was no resistance. However, if there was resistance it may require force or persuasion to make the new systems work. These approaches could apply to health professionals who could receive incentives or penalties if they failed to be technologically ready to use HIT. Forces or pressures used could be in the form of government regulations, workforce requirements or other forms of enforcement.

Concepts and Tools to Measure TR

Measuring the TR of health professionals is similar to measuring the readiness of individuals who are encouraged or required to engage in paradigm shifts such as greater use of technology. The willingness or pre-disposition of individuals to accept new technologies represents their pre-disposition to engage in paradigm shifts and greater knowledge about TR will provide information for application to encourage paradigm shifts when required by federal policies.

The definition for TR was the "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (Parasuraman & Colby, 2001, p. 18). These characteristics applied to all individuals engaged with technologies of all types, including health professionals. For example, when marketers prepare to

present new retail technological products they rely on marketing research and data that describes the attitudes of consumers and their propensity to purchase new technology products. The data collected enables marketers to introduce new products efficiently and successfully.

In the health industry there is a similar need for health providers to understand the propensities of the workforce regarding using new technology products. Like consumers, a health professional workforce may accept or reject new technologies. Failure to use methods to assess the attitudes of health professionals could be costly and inefficient for government and the private sector. Parasuraman and Colby identified 4 primary elements of TR that should be considered when introducing new technologies to consumers. Those elements used as variables in this study are optimism, innovativeness, insecurity, and discomfort. This study relates those elements to attitudes of health professionals.

Parasuraman and Colby (2001) found in qualitative analysis that there were positive and negative feelings expressed in response to technology. They found that TR was more complex than the categories outlined by Rogers (2001) of innovator, early adopter, late adopter, laggard and that the concept of TR included a range of feelings and emotions of high, medium and low readiness. Parasuraman and Colby described emotional reactions to technology as experiences, attitudes, beliefs and questioned whether most individuals actually sought technology or if they needed coaxing to accept technologies being introduced by outside sources (Parasuraman & Colby, 2001). The researchers produced a continuum to illustrate their analysis of high, medium and low

levels of TR that could be measured on a scale where resistance to technology was low and receptivity to technology was high (Parasuraman & Colby, 2001).

In addition to measuring responses as high, medium, and low, Parasuraman and Colby (2001) classified TR in the four distinct domains noted earlier of: optimism, innovativeness, insecurity and discomfort (Parasuraman & Colby, 2001). They believed that optimism and innovativeness contributed to an individual's TR, while discomfort and insecurity inhibited TR. They referred to contributors and inhibitors as "drivers" of behaviors (Parasuraman & Colby, 2001).

Four drivers of TR by Parasuraman & Colby include:

1. Contributor to TR--Optimism: "positive view of technology and a belief that it offered people increased control, flexibility and efficiency in their lives" (Parasuraman & Colby, 2001, p. 34). This optimism was reflected by users who enjoyed using computers; felt that they accomplished more and were doing more than they did a couple of years ago; felt mentally stimulated and looked forward to using new technology products and services. Younger users tended to be more optimistic than older individuals were and both males and females harbored some doubts (Parasuraman & Colby, 2001).
2. Contributor to TR--Innovativeness: "a tendency to be a technology power and thought leader" (Parasuraman & Colby, 2001, p. 38). These individuals were open to learning new and different technologies; they liked to keep up with the latest developments; they enjoyed the challenge of figuring out high tech gadgets; believed others came to them for advice regarding technologies; and were among

the first to acquire a new technology in their group. Most of the innovative consumers were under the age of 50 years and the majority of the innovators were male (Parasuraman & Colby).

3. Inhibitor of TR--Discomfort: "Perceived lack of control over technology and a feeling of being overwhelmed by it" (Parasuraman & Colby, 2001, p. 41). This represented a certain paranoia that individuals had regarding technology-based products and services. They believed technology excluded people rather than including them. They did not think technology was designed for ordinary people and that technical people strived to take advantage of individuals who did not understand technology, as well as they did. This group did not think tech-support personnel explained technology issues very well and did not believe manuals were written in plain English (Parasuraman & Colby 2001).
4. Inhibitor of TR—Insecurity: "distrust of technology and skepticism about its ability to work properly (Parasuraman & Colby, 2001, p. 44). The insecurity regarding technology manifested itself in fears about giving out credit card numbers; not feeling confident when doing business on-line; and not wanting to provide information over the Internet because the individual did not believe it would go to the right place. Individuals who were insecure also believed that switching to a new technology was risky and that technology could fail at the worst time.

Parasuraman and Colby (2001) found that some consumers believed in technology while others feared or were confused. Based on insights from focus groups, researchers

found that fearful consumers believed technology spreads pornography; contributed to surveillance by "Big Brother;" contributed to information overload, disseminated unreliable information; created a loss of human interaction; increased the gap between the wealthy and the poor; created a loss of national and cultural identity and fostered criminal and terrorist activities.

Over time, Parasuraman and Colby (2001) became convinced there were five groups of individuals who reacted to technology in positive and negative ways and the TR of those individuals could be affected by positive drivers and negative inhibitors. The descriptions used to describe the personalities were explorers, laggards, pioneers, skeptics and paranoids and each personality type required different types of interventions for promotion of their TR. The categories listed by Parasuraman and Colby (2001) were similar to categories of technology adopters listed by Rogers (2003) but, varied somewhat in the characteristics described. Both sets of researchers included laggards as the slowest group to accept technology.

Table 3 outlined some of the consumer beliefs, fears and confusion about technology that emerged from a survey known as the National TR Survey (Parasuraman & Colby, 2001). It should be noted consumers researched reported feeling conflicting simultaneous positive and negative feelings about use of new technologies. The paradoxical feelings reported by consumers ranged from optimism and belief in the benefits of technology to fears about giving out credit card numbers over the Internet and lack of confidence regarding doing business over the Internet.

Table 3

Consumer Beliefs, Fears, and Confusion about Technology

Consumers believe in benefits of technology
Consumers believe computers are easier to deal with than people
Consumers are skeptical about displacing people in transactions
90% of consumers believe the human touch is important when doing business
Consumers possess a degree of skepticism about using technology for new areas like ecommerce
Perhaps the greatest obstacle to ecommerce is related to perceived security and the need for assurance regarding the transaction
77% of consumers do not consider it safe to give out a credit card number over a computer
67% do not feel confident doing business with a place that can only be reached online

Note: Developed by S. Myers, 2009. Based on findings of National TR Survey, Parasuraman, and Colby, 2001

Table 4 listed who ranged in attitudes about technology from explorers who were are high in TR and similar to the venturesome group described by Rogers (2005), to skeptics who lacked desire for innovations, to paranoids who like late adopters found technology fascinating but, frightening (Rogers, 2005). Both groups agreed there were laggards who were the very last to adopt innovations (Parasuraman & Colby, 2001).

Table 4

Five Types of Technology Customers

Explorers: Extremely high in TR, ranking high on drivers and lower on inhibitors of adoption. Easy group to attract when a new technology is introduced; comprises first wave of customers.
Pioneers: Share the optimism and innovative tendencies of Explorers but, have some degree of discomfort and insecurity. Drawn to the use of technology but, encounter obstacles and need assistance. They are usually the next group behind Explorers to try technology but, need help to make it work.
Skeptics: This group follows Explorers and Laggards. They are dispassionate about technology and do no believe strongly in technology and lack the desire for innovations. They lack inhibition, ranking low in discomfort and insecurity and require convincing that the new product or service will benefit them. Once convinced however, they progress quickly.
Paranoids: These individuals find technology fascinating but, frightening. They are optimistic but, lack a tendency to innovate. They exhibit high degrees of discomfort and insecurity and need convincing that they will benefit from the technology. They require support and reassurance.
Laggards: Opposite of Explorers, ranking lower in motivation and higher in inhibition that the market as a whole. These people are the last individuals to adopt new technology. They often have to be forced to accept a new technology when the old ways of doing things are no longer available.

Table prepared by S. Myers, based on Parasuraman & Colby (2001).

In the marketing industry, Parasuraman and Colby (2001) identified 4 primary strategies for marketing technological products to consumers. The first strategy was "technology evangelism" (pp. 107-113). Technology evangelism entailed using sales techniques analogous to propaganda or arousing emotional support around a product or service. In the health sector, *technology evangelism* might be similar to public service

campaigns that promote specific issues through public service advertising, media, social networking or other emotional appeal strategies.

A second strategy used in marketing to encourage individuals to use new technology was "future ready design"--described by Parasuraman and Colby (2001) as the process of introducing new technologies at a time when consumers or individuals were ready to use them (Parasuraman & Colby, p. 113-124). An example of "future ready design" would be introduction of new technology to individuals who are optimistic about technology and display high levels of techno-readiness with recognition that skeptics and paranoids would follow their lead and adopt the new technologies later (Parasuraman & Colby, 2001). In the health sector, examples of future ready design would be innovative technology applications such as online electronic medical records or robotic surgery tools and these future ready designs would be accepted first by early adopters, explorers and pioneers who had high levels of TR and accepted later by skeptics, paranoids, and finally laggards.

"Proving Benefits" was a third element that provided incentives to encourage use of new technology (Parasuraman & Colby, 2001, p. 124). This applied when individuals did not understand the benefits of a proposed innovation and would not use it unless incentives or rewards were offered. During the future-design stage, "proving benefits" were less important to explorers and pioneers who had high levels of TR and were willing to adopt new innovations. However, when skeptics were presented with new technologies the proving benefits was more significant because skeptics did not automatically adopt new technology but, weighed costs, utility and other benefits

(Parasuraman & Colby, 2001). In the health sector, proving benefits would be significant for health professionals with scientific backgrounds and ethical considerations with responsibility for patient care and safety.

Another strategy cited by Parasuraman and Colby (2001) that encouraged techno-ready individuals to adopt new technology was "market-stage pricing". Parasuraman and Colby indicated it was not uncommon for "the price of new technologies to drop steadily after introduction to the market" (p. 134). While according to Parasuraman and Colby lower prices for new technology products does not impact explorers and pioneers who have high incomes, lower prices do have an impact on skeptics, paranoids and laggards. They refer to examples of product introductions where high costs discouraged use but, later more affordable pricing spurred utilization. They used examples of lower pricing for hardware and software that could assist with promoting acceptance of new technology to targeted groups (Parasuraman & Colby, p. 135).

When managers prepare to launch a new technology to a target population they should consider using TR data from the TRI survey to assess the willingness or unwillingness of the target populations to use the new technology. This applies to health managers who introduce new technologies to health professionals. If they discover reticence or resistance on the part of health professionals regarding adoption of new technologies there may a need for the strategies described by Parasuraman and Colby (2001) that coax or encourage users with interventions or incentives. While the strategies outlined by Parasuraman and Colby were used in the marketing industry, the techniques

and approaches could be modified to apply to fostering TR in other sectors, which could include the health sector.

In addition to TR there are other theories regarding acceptance of innovations and technologies. Many of these theories evolve from information technology and computer science. One key theory presented by Fred Davis (1989) was called 'ease of use", where Davis observed most research described user acceptance of technology based on qualitative research and lacked quantitative analysis. To respond to this gap, Davis developed a theoretical construct to quantitatively measure the factors that cause individuals to accept or reject technology. He identified two determinants in his theory: (a) perceived Usefulness--when individuals believe the technology will help them to perform their jobs better, and (b) perceived Ease of Use—the degree to which a person believes that use a particular technology is easy (Davis, 1989).

Two theories were presented by Davis (1989)—first, the first theory of self-efficacy where outcome judgments are linked to valued outcomes; and second, a cost-benefit paradigm based on behavioral decision theory—where individual choices among decision-making strategies are a trade-off between the efforts required to employ a particular strategy and the quality or accuracy of resulting decisions. In 1992, Davis collaborated with psychology and business professor Richard Bagozzi to incorporate his theories into a survey tool called the Technology Acceptance Model (TAM) (Davis & Bagozzi, 1989). The TAM provided a survey approach to measuring TR and technology acceptance and studied user acceptance based on computer science principles.

The concepts and formulas of the TAM are similar to the TR Index however, because the TAM was a computer science tool it was somewhat more technical than the TRI developed by Parasuraman and Colby (2001). The TAM measured the technology elements of a product or software rather then the predisposition and attitudes such as the variables in this study of optimism, insecurity, discomfort, and innovativeness. However, both methods measure individual attitudes are would be relevant to health professionals.

Another method to assess technology readiness among health professionals was conducted in 1996 by the Organizational Information Technology Innovation Readiness Scale (OITIRS). Results of the study were discussed by Snyder and Fields (2006) as an methodology to assess the technology readiness of entire medical institutions--not only the individual health professionals. Development of the OITIRS was partially encouraged by a Institute of Medicine report that emphasized the need for health care organizations to increase their use of information technology to improve patient safety (Institute of Medicine Report, 2001). Snyder and Fields based their study on the premise that complex institutions like hospitals faced difficulties in integrating organizational innovations into their operations (Snyder & Fields, 2006).

The difficulties cited by Snyder and Fields (2006) in their study described examples of changes that occurred in hospitals working to integrate HIT and other innovations. They evaluated the OITRIS instrument to determine if it could measure the TR of hospitals and other medical institutions and they concluded that it was. The OITRIS, as described by Snyder and Fields (2006) measured a number of organizational sub-dimensions to determine the TR of hospitals that included resources, end-users,

technology, knowledge, processes, values and goals, management structures and administrative support (Snyder & Fields 2006). The analysis of the OITRIS examined values similar to the TRI Index assessment of attitudinal variables such as optimism, insecurity, discomfort, and innovativeness but, in addition, the OITRIS examined other elements as well that went beyond the scope of the attitudes of health professionals.

Researchers have modified the TRI to make it more usable for varying situations. In the working paper, "Rethinking Readiness: Development and Validation of a Reduced Form of the TR Index," Barnhart and Ratchford (2007) reviewed the original TRI scale of 36 questions and concluded that 36 items were too extensive to measure optimism, innovativeness, discomfort and insecurity and resulted in decreased response accuracy due to response accuracy, response fatigue and acquiescence bias (Barnhart & Ratchford, 2007, p. 110). Using more stringent standards, Barnhart and Ratchford developed a TRI scale with 3 instead of 4 factors that included *optimism, innovativeness* but, merged insecurity and discomfort into the factor *apprehension.* Apprehension was defined as "distrust of technology and anxiety regarding its ability to perform properly" (Barnhart & Ratchford, 2007, p. 110).

When Barnhart and Ratchford reduced to TRI scale from 36 questions to 17, they measured apprehension, distrust of technology and anxieties regarding the reliability and ability of technology to perform properly (Barnhart & Ratchford, 2007). They administered the modified TRI to individuals who responded to questions about past and present technology usage to determine why some adopted technologies slower than did

others, why others displayed 'laggard' characteristics or were hesitant to embrace a particular innovation or technology.

The literature found only several practical applications of the TRI instrument in health settings. One research study conducted by Caison, Bulman, Pai and Nevelle (2008) investigated the TR of nursing and medical students in Newfoundland and Labrador, Canada (2008). They administered the TRI to first year students to determine their predisposition towards using technology and their TR and collected demographic data based on urban versus rural points of origin, age, gender, type of program and medical or nursing specialty. Researchers conducted descriptive analysis, chi-square, Fisher's exact tests, and independent sample t-tests analysis to explore differences between nursing and medical students and their TR responses (Caison, Bulman, Pai & Nevelle, 2008).

Differences emerged among medical students regarding gender and innovation where male students reported significantly higher mean scores for innovation and positive TR than females who had negative TR scores. Medical students 25 yrs and older had negative TR scores while students under 25 had positive TR scores. Moreover, rural nursing students reported greater insecurity with technology than did their urban counterparts (Caison & Bulman, 2008). Data obtained from rural students indicated insecurity with technology and unfamiliarity with computers. Researchers conjectured that rural students had distrust of technology and skepticism about the ability of technology to work properly (Caison & Bulman, 2008). Their conclusion was rural students would benefit from increased use of new technologies in health study curriculum

and classrooms and technology should be integrated into classes rather than be taught separately. Further, they noted that Canada's effort to institute electronic medical records and other technologies for clinical practice would depend on the capacity of graduates to embrace new technologies i.e. to be technologically ready. Researchers noted that special efforts would be needed to assist rural, female and over 25 yr old students to close gaps in unreadiness and that attention should be given to continuing education efforts.

Parasuraman, the primary developer of the TRI discussed a gap in the literature regarding the effect of the growth in self-service technologies that required individuals to serve themselves by interacting with technology in both goods and services (Parasuraman, 2000). He observed that businesses increasingly viewed themselves as service providers with an emphasis on customer service and had expanded their concept of customer service to extend beyond customary industry boundaries. Parasuraman believed there was a need to research interactions between customers and technology through service encounter research and developed the TRI as the instrument to conduct that research (Parasuraman, 2000, p. 307).

Traditionally, customer relations have focused on external marketing however, Parasuraman observed that internal marketing has evolved as a concept that regarded service personnel as "internal customers" who are as important as "external customers" in the service delivery process (Parasuraman, 2000, p. 308). Service personnel would be analogous to health professionals who interact with patients on a regular basis. According to Parasuraman, internal marketing provides employees with training, support, motivation and even rewards and incentives to improve their delivery of service to customers

(Parasuraman, 2000, p. 308). Similar approaches of training, support, motivation, and rewards should be considered to assist health professionals with adopting new interventions. Parasuraman discussed the expanded role of technology in internal and external marketing and suggested that the impact of interactive technology on the marketing environment was not well understood. He described a technology-employee and technology-customer linkage that is part of the conceptual framework for the TRI a "multiple-item scale to assess people's readiness to interact with technology" (Parasuraman, 2000, p. 308).

Research by Mick and Fourier (1998) was referenced by Parasuraman that discussed simultaneous favorable and unfavorable reactions of individuals to technology and applied the behavioral paradoxes that Mick and Fourier outline to his conceptual underpinning of the variable of the TRI scale (Mick & Fournier, 2000 as cited in Parasuraman, 2000). Overall, Parasuraman believed there was a need for a "thorough assessment of customers TR" (Parasuraman, 2000, p. 317) based on the tremendous growth of technology based products and services. He believed the examination of the scores produced on the TRI scale assisted organizations to answer questions germane to their technology strategy, management of customer-technology linkages described in the pyramid model (Figure 7) and provided comparisons to responses from consumers as measured by the NTRS--the national consumer survey conducted annually by Parasuraman and Rockbridge Associates (2000). Parasuraman (2000) also believed there was a "need for comparative studies of TR across countries and cultures" (p. 319).

Another model that evaluated how individuals adopted new technologies and their decision-making process was the Model of Adoption of Technology in Households (MATH) model developed by Brown and Venkatesh (2005). They examined the impact of technology decisions in households and how those decisions were made. Instead of examining the TR of a particular workforce, they focused on normative and control beliefs regarding technologies that adult individuals have and use in their own households. Brown and Venkatesh (2005) found that income was not the determining factor in home use of technology and that dynamics were complex and were affected by the presence of children, fears of technology among older individuals and individual lifestyles (Brown & Venkatesh, 2005). They found that households with children were earlier adopters than households without children. As home-based health technologies diffuse into society, the MATH model could be useful to measure the perceptions and TR of health professionals who work from home and use HIT, home-based health services via telemedicine and electronic medical records for themselves and their patients.

The Adaptive Structuration Theory (AST) model evaluated emerging social networking systems and how those systems incorporated many features of interaction and ways use of technologies (DeSanctis & Poole, 1994). AST investigated the effect of advanced information technologies on organizational change. One observation raised by DeSanctis and Poole (1994) was that social networking processes had the unintended consequence of instituting social dominance over *communications* and interactive systems. Examples of social networking systems referred to in their research were

distance education, remote communications networks, and remote applications that involved interactive systems.

It is significant to note that the authors made their observations in 1994 without the benefit of knowledge regarding societal diffusion of contemporary social networking tools such as global distance learning universities, ubiquitous email, cell phones, Facebook, Twitter and other social networking tools. Their view that social dominance could result from networking and such dominance could be positive or negative for users in social systems could apply to the health sector.

Unlike the TRI, the AST did not measure TR, but instead focused on advanced social networking applications. For the purpose of this study, the TRI continues to be the more appropriate instrument for analysis of TR among health professionals. In future research regarding attitudes and use of social networking technology among health professionals, the AST could be an excellent methodology to examine the effect of increased use of social networking technology for health communications and patient contact. For example, remote video systems and computers that monitor the health conditions of patients may increase the use of social networking software that has the capacity to link remote locations for health communications, diagnostic and treatment. Contemporary use of social networking systems demonstrate positive and negative applications for business, pleasure and personal use and the AST warrants further research to measure the potential positive and negative outcomes for the health system.

When developing a measurement tool known as TAM 3, Venkatesh and Bala (2008) modified Davis's TAM to evaluate respondent reactions to managerial support

and involvement in adoption of new technologies. They found a basis for legitimate technology un-readiness or apprehension based on the potential financial impact of a new technology or the potential for rejection by the workforce. Venkatesh and Bala developed TAM 3, as an extension of the Technology Adoption Model (TAM), developed by Davis in 1989. Venkatesh and Bala modified the TAM, to TAM 3 to identify disparities that emerged between large investments in IT and the potential for non-use or low acceptance levels among employees.

As in the original TAM constructs (Davis, 1989) Venkatesh and Bala (2008) determined there was some relevance among employees at companies regarding perceived usefulness, job relevance, output equality, results and perceived ease of use. However, when those factors were not present employees may not have engaged the technology and IT investments could be wasted (Venkatesh & Bala, 2008). In other words, a major capital investment in technology could be lost if there was not sufficient attention paid to ease of use and perceived usefulness. Venkatesh and Bala found that experience with technology and a feeling of voluntariness rather than compulsory requirements were factors that influenced employee acceptance of new technologies. Those findings should be useful for healthcare providers who are introducing HIT and need to measure managerial support along with TR.

Findings in TAM 3 indicated that low adoption and underutilization of technology were in conflict with large investments in IT and expected increases in productivity. Venkatesh and Bala (2008) suggested that managers needed assistance with determining the elements of perceived usefulness and ease of use that addressed individual

differences, system characteristics, social influences and facilitating conditions (Venkatesh & Bala, 2008).

As this study was conducted, with the TRI regarding the TR of health professionals findings that emerged that indicated apprehension or insecurity regarding technologies and innovations were considered within the theoretical framework of the analysis of Venkatesh and Bala (2008), who asserted that apprehension was an element to consider when evaluating the impact of readiness on investments in technology.

In TAM 3, Venkatesh and Bala (2008) identified disparities between large investments in IT and the potential for non-use or low acceptance levels among employees. They determined there was some relevance among employees at companies regarding perceived usefulness, job relevance, output equality, results and perceived ease of use, however when those factors were not present employees may not engage the technology and IT investments could be wasted (Venkatesh & Bala, 2008). In other words, Venkatesh and Bala (2008) found that major capital investments in technology could be lost if there was sufficient attention to ease of use and perceived usefulness. Venkatesh and Bala (2008) found that individual experience with technology and a feeling of voluntariness rather than compulsory requirements were factors that influenced employee acceptance of new technologies. Findings by Venkatesh and Bala could be useful for healthcare providers introducing new technologies who needed to determine if non-use or low-use among health professionals could result in costly delays or rejection of HIT and other health technologies.

Digital Divide

In the 1995 report, "Falling Through the Net: Towards Digital Inclusion" produced by the U.S. Department of Commerce, National Telecommunications Information Administration, disparities in society were documented regarding access and adoption of technology. It was determined that significant gaps existed among various populations, ages, and ethnic groups (U.S. Department of Commerce, 2009). In Barbara Wejnert's (2002) journal article, she found that there were disparities in societies, communities, and organizations that affected acceptance or familiarity of an innovation and that the socio-economic status of individuals, communities, or entities in a society could push innovations faster or slower. As a result, digital divides emerged among socio-economic groups that had either unique access to innovations or lacked access to them entirely. Wejnert's observations indicated the position and economic power of innovators or opinion leaders affected how innovations were absorbed into society and how those innovations were disseminated to institutions and individuals (Wejnert, 2002).

According to Wejnert, unequal diffusion resulted in disparities as well as contributed to digital divides within populations (2002). Given that health professionals are a sub-set of American society, it is important to consider that there could be elements of digital divides among that population. Further research is needed to determine how or if the digital divide, manifests itself among health professionals regarding their positive or negative TR. To assist with determining whether digital divides exists among the sample of health professionals demographic data is reviewed including health occupation, geography, race, gender, and age.

Opportunities for Social Change

Based on the concepts and analysis of the scholars reviewed in this section significant social change can result from the introduction of new technologies into the healthcare system. Based on federal initiatives cited earlier and a consensus report produced among experts by the Institute of Medicine (IOM), it has been determined that the environment of the healthcare delivery system must be redesigned to improve quality and serve the needs of society in the 21st century (IOM Report, 2001, p. 5). Inherent in the concept of redesigning the healthcare system are major changes that will result in social change at all levels of the health sector and among diverse health occupations. Based on the IOM Report, funding announcements from the Secretary of the U.S. Department of Health and Human Services and other federal departments, the increased introduction of technology into the healthcare system is one of the major priorities for change that will affect health professionals and their TR. The IOM Report stated:

> The challenges of applying information technology should not be understated… Health care is one of the most, if not the most complex sector of the economy...Widespread adoption of many information technology applications also require behavioral adaptations on the part of clinicians, organizations and patients. (IOM Report, 2001, p. 5)

The systematic and organized use of TR that is consistent with societal goals can advance federal plans to integrate technology into the healthcare system and result in positive social change. However, the reverse is also true. If laggard and technologically unready health professionals resist the increased use of technology in healthcare there is a

possibility that diffusion of new technologies to those groups could fail. If failures occur and are in strategic parts of the healthcare system there could be unanticipated negative outcomes and significant financial loss of expenditures used to acquire new technologies that go used or underutilized. Therefore, assessing the TR of strategic health professionals in advance could identify early problems, be useful for planning, and redesign strategies.

There are wide ranges of innovations and technologies in the marketplace and it may be reasonable for health professionals to be apprehensive or skeptical of some of those technologies and their potential impact on society. Innovations and technologies that can radically change culture and societies should be examined carefully by physicians, nurses, and other health professionals. For example, advanced technologies with sophisticated capabilities may radically alter patient care resulting in positive social change. However, other advanced technologies may have unintended consequences and require further study.

Conclusions

There are differences in Rogers's (2003) views regarding systemic diffusion of innovation from Fishbein and Ajzen (1975) and Mick and Fournier's (1998) views regarding individual attitude formation and paradoxical attitudes. Individual attitude formation and paradoxical attitudes occurred in individuals when they responded to innovations. Diffusion of innovation theories described the processes that occurred within systems or societies. Both theories are relevant to the study of health professionals because individual health professionals form positive and negative attitudes

toward technology and those predispositions are measured by the TRI survey. The systemic perspectives regarding diffusion of technology were also relevant based on the role of health professionals within organizations and systems.

Theories about early adopters contrasted with theories about laggards and late adopters show either where some individuals adopted technologies early, late or not at all unless forced to or provided with incentives. Those theories illustrated the process of how innovations were diffused rapidly within systems when opinion leaders promoted new ideas. In addition, discussion regarding the role of incentives and the potential for diffusion of new technologies that transpired through S-Curves (Rogers, 2003) provided ideas that could be used to accelerate TR.

Mick and Fournier's observations (1998) regarding paradoxical attitudes of individuals regarding new technologies provided a significant context for findings in this study when mixed results were found in survey responses. The analysis of paradoxical thinking provided a basis to interpret data where individuals reported they were simultaneously attracted and repulsed by innovations and new technologies. Barker's (2004) observations regarding hidden or subtle leaders provided awareness that the obvious opinion leaders are not always the most prevalent or persuasive with groups or societies and that those hidden leaders can have impact on the diffusion of innovations or the rejection of new technologies.

The concept of TR was compared to an internal marketing issue by Parasuraman (2000) and this suggested the need to consider the impact of technology in business environments and the role of service providers in the healthcare sector. If health

professionals were service providers they would be part of the internal environments who need training, support and perhaps even rewards and incentives to motivate them to integrate technology into their service delivery systems. Parasuraman's (2000) observations about the role of technology in internal and external customer relations are relevant to health professionals who interact with the public internally in health-provider settings and externally in the larger community.

Rogers (2003), Parasuraman (2000, 2001) Mick and Fournier (1998) and Caison and Bulman et al. (2008) believed TR characteristics were identified by belief systems and responses of individuals to technology. While the scholars used different terms to describe the characteristics Parasuraman termed 'TR' (2000) there was consensus that individuals and groups in diverse cultures, social strata and economic groups adopted technology in different ways, at different levels and at different times. This consistency of analysis provided a conceptual framework for the survey in this study and provided a basis to interpret the responses of the sample of health professionals (Parasuraman & Colby 2001; Rogers, 2003).

Spicer (1952), Rogers (2003), and Agarwal (1998) agreed that technology and innovations could change or alter cultures and society if their introduction to society was mismanaged. This conclusion should encourage policymakers to take great care with introducing innovations and technologies into societies and cultures in order to avoid consequences that could last for generations. In the view of this author, Spicer's (1952) observations were relevant to the TR and predisposition of health professionals in the early 21st Century. Federal plans to increase diffusion of health technologies into society

should be considered in the context of how health professionals regard those technologies and plans to implement them. Chapter 5 of this study suggests approaches for such considerations.

The discussion about early adopters, opinion leaders, and innovators as influential in social and professional groups offers great promise for health professionals (Parasuraman & Colby 2001; Rogers, 1995; Wejnert 2002). Their role as societal opinion leaders could assist to increase diffusion of new technologies into the health system, and other segments of society. Training models that facilitated rapid diffusion of innovation could be created based on TR assessments and inclusion of change agents and opinion leaders drawn from optimistic health professionals. Early adopters and opinion leaders including explorers or pioneers could assist with the diffusion of health technologies and HIT to laggards and others who require time to develop TR, overcome fears and apprehensions and adopt innovations. Managers and health professionals who emerge as innovators or early adopters can be opinion leaders who serve as role models for late adopters and laggards—thus performing a meaningful public service and social change.

In those instances where technological unreadiness is based on cultural habits and customs there could be irreparable damage caused by introduction of technologies where there is a lack of fit (Kuhn, 1952). Where such cultural barriers exist, it may be unwise to label health professionals in those cultures as "late adopters, laggards or paranoids" as Rogers (1995) and Parasuraman (2001) suggest but, instead to use timing and rewards to encourage skeptics to reconsider the value health technologies could have in their

societies. As Spicer (1952) indicated, the society must see a benefit if there is a prospect of radically changing the culture with innovation or change. In addition, TR should be regarded as only one factor along with cost benefit analysis and the long-term impact on budgets and resources (Wejnert, 2002).

Mick and Fournier (2003) discussed paradoxical attitudes of individuals towards technology and their simultaneous conflicting feelings of wanting to use new technologies while at the same time being nervous or afraid of those same technologies. Understanding these paradoxes is critical to decision-makers who seek to interpret the response of individuals in a workforce when they are confronted with change. Finding ways to assist health professionals to overcome their simultaneous positive and negative feelings requires new models (Mick & Fournier, 2003). Increased understanding of the elements that contribute to either acceptance or rejection of technology can enable organizations to replicate successful introduction of new technologies, refrain from unsuccessful strategies, and improve decision-making. In addition, comparative analysis can be conducted with TRI studies across countries, cultures, and industries.

During a national period of intense attention on the health system, the themes that emerged from the literature review of Kuhn (1962), Spicer (1952), and Mick and Fournier (1998) should enable decision-makers to create a construct for technology administrators who are responsible for managing the introduction of new technologies into the health system. Given the importance of the healthcare system, there should be a societal imperative that analyzes factors needed to maximize success regarding diffusion of new technologies into health. Measuring TR can assist with avoiding unexpected

negative consequences and as a result, future generations can benefit from an improved healthcare system.

Chapter 3: Research Methods

This chapter reviews development of the TRI instrument, including its methodology, design, reliability, and limitations. Background is provided regarding development of the instrument and the intellectual constructs that provide the basis for the 4 variables used in this study. This chapter outlines the process used to determine the sampling frame, identification of target population, survey strategy, data collection, and methods used for data analysis.

The TR Index was selected as the instrument for this survey after careful review of several models that evaluated different elements of TR. The 36, 10, and 6 question versions of the TRI were considered, and the 10-item TRI was selected based on its validity and capacity to measure high, medium and low TR. The TRI 10-item index was also determined to be compatible with the online survey strategy of distribution of the instrument through Survey Monkey. The TRI provides a quantitative analysis of the relationship of independent and dependent factors that contribute to TR, including 4 variables (also referred to as domains) described as optimism, insecurity, innovativeness, and apprehension. A copy of the 10 Item TRI instrument is in Appendix A.

Research Design

The research design for this study began with identification of a social issue for study: the TR of health professionals. This social issue was based on analysis of federal government efforts to diffuse technologies into the health sector through funding initiatives, federal polities and legislation (U.S. Department of Health and Human Services, 2010). Given the size and scope of the health sector, it was determined that this

was a valid social issue and therefore, an appropriate topic for social research. The research design for this study was based on 7 major steps outlined by Singleton and Straits (2004) regarding approaches to social research. The seven stages were: (a) formulation of the research problem, (b) preparation of the research design, (c) measurement, (d) sampling, (e) data collection, (f) data processing, and (g) data analysis and interpretation (Singleton and Straits, 2004).

First, the research problem was to determine the positive and negative technology readiness (TR) of health professionals based on the priority established by the federal government to increase diffusion of technologies into the health system. Four hypothesis were established to test how a random sample of health professionals perceived TR in relationship to 4 variables. The second step, preparation of the research design, resulted in designing a quantitative study with the objective of conducting probability analysis of a sample of health professionals to evaluate their TR.

Third, the measurement instrument used for the quantitative study was a copyrighted survey instrument called the Technology Readiness Index (TRI). The 10 question version of the TRI was selected as the appropriate instrument for the study. Next, a sampling frame of 1,000 individuals was identified, and 72 health professionals were calculated for the sample using power analysis. Data collection was conducted by email from randomly selected individuals, and after the data were collected it was processed and downloaded into SPSS software, where it was edited, coded and processed into data matrixes. Statistical tests were conducted to analysis the results including tests

to determine the average mean, compare means, establish correlations and present descriptive statistical data (Singleton & Straits 2004).

History of TRI Instrument

The TRI was developed by Parasuraman and Colby in 1999 to assess the TR of consumers, employees, citizens-at-large and students (Parasuraman, 2000). Although it has been applied in financial services, consumer electronics and technology fields, literature searches indicate that the TRI has rarely been applied to the health sector. Therefore, it was determined that application of the TRI instrument for this study could contribute to the body of knowledge, and a request was submitted to developers to use their copyrighted instrument, and authorization was provided (see Appendix B).

Research leading up to the development of the TRI focused on shifts from product-based marketing to service-based marketing and how an analysis of how those shifts were affected by the integration of technology into interactions with employees, customers and the companies (Parasuraman, 2001). As Parasuraman (2001) evaluated the elements intrinsic in technology-employee and technology-customer links, he developed the TRI in collaboration with Colby to assess the readiness of individuals and their attitudes. In partnership with Rockbridge Research, Parasuraman conducted an annual National TR Survey (NTRS) that evaluated consumer TR in marketing industries, financial markets and most recently in environmental readiness (University of Maryland, National Technology Readiness Survey, 2009).

History of Technology Readiness Concepts

TR is defined by Parasuraman (2000) as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work and the overall gestalt of mental enablers and inhibitors that collectively determine a person's predisposition to use new technologies" (p. 308). The attitude or predisposition of an individual toward technology is an important element to understand when new technologies are presented to individuals or organizations.

There are a number of questions that must be considered when examining the TR of individuals such as: (a) what are the primary elements of TR? (b) can populations be grouped into segments to determine their readiness? (c) if yes, can those population segments be differentiated based on economics, education, race, age, or lifestyle? (d) what are the considerations that should be taken into account to address these elements? (Parasuraman, 2000). All of these questions are considered in this study.

This study applied the TRI instrument to a sample of health professionals to evaluate their TR to determine if they are prepared to adopt new technologies in healthcare service delivery. Results were evaluated in the context of the continuum of attitudes developed by Parasuraman and Colby (2001) that captured positive and negative feelings in TR where positive feelings may propel people forward and negative feelings may hold them back (Parasuraman & Colby, 2001). The construct of technology paradoxes developed by Mick and Fournier provided a context for measuring conflicting responses from health professionals in relationship to the 4 variables of optimism, innovativeness, insecurity and discomfort.

Development of TRI

The TRI survey was based on research conducted with consumers in order to generate an initial pool of questions. Parasuraman and Colby (2001) conducted pilot studies with Sallie Mae, a mortgage bank company, and an unnamed on-line company to compile questions and perspectives regarding TR. More than a dozen focus groups were conducted on general themes regarding technology use that identified a broad series of positive questions and apprehensions on the part of consumers. A pool of sixty-six items emerged from the qualitative analysis strategy and pilot studies. The resulting sixty-six questions were analyzed consistent with Churchill's (1979) paradigm for scale development.

After evaluating the sixty-six questions, Parasuraman and Colby reduced the list to 58 items that were factor analyzed and organized into 4 major categories that addressed positive and negative factors of TR: (a) optimism, (b) innovativeness, (c) discomfort, and (d) insecurity. Further review and analysis reduced the number of questions to thirty-six items consisting of 10 items for optimism, 7 items for innovativeness, 10 items for discomfort, and 9 items for insecurity. The resulting thirty-five questions composed the basis for the completed original TRI scale.

In a separate study Barnhart and Ratchford (2007) reviewed the original TRI scale of 36 questions and concluded that 36 items were too extensive to measure optimism, innovativeness, discomfort and insecurity and resulted in decreased response accuracy due to response fatigue and acquiescence bias (p. 110). Parasuraman and Colby also determined that the 36-item scale was too long and developed a version of 10 questions

compose the TRI 10-item scale used in this study. The reliability and composition of the 10-item scale was evaluated and discussed later in this chapter.

Reliability and Validity of Original TRI

The reliability estimate of the original TRI was based on Cronbach's alpha to determine well the items or variables measured the single construct of TR. Cronbach's alpha established coefficients of reliability and consistency among the items on the TRI survey by measuring a single unidimensional latent construct. A coefficient alpha was calculated for the first set of 66 items developed for the TRI drawn from focus groups and pilot tests. Those items were analyzed using an iterative scale purification process based on Churchill's methodology that computed a coefficient alpha for each of the variables of optimism, innovativeness, discomfort, and insecurity. After reducing the items from 66 to 58 and re-computing the alpha coefficients for the 4 subsets the alpha values improved ranging from .79 to .81.

Parasuraman and Colby then performed a factor analysis on the reduced pool of 58 items to verify their dimensionality and a four-factor solution was obtained and subjected to a varimax rotation that resulted in some of the items having low loadings on more than one factor (2001). To determine content validity, the TRI survey instrument was applied to Churchill's procedure following an eight-point process to include: (1) specify domain of construct; (b) generate sample of items; (c) collect data, (d) purify measures, (e) collect data, (f) assess reliability, (g) assess validity, and (h) develop norms (Parasuraman & Colby 2001, Churchill, 1979).

Based on those procedures, the TRI was determined to have a high reliability and consistent factor structure when the four TRI dimensions of optimism, innovativeness, discomfort, and insecurity were evaluated for trait validity (Parasuraman & Colby 2001). The construct validity of the four dimensions were determined by face and content validity asking basic questions whether the scales appeared to measure what they were supposed to measure and whether the scale items captured key facets of the unobservable constructs being measured with regard to TR. The TRI met the criteria of content validity with scales based on multiphase research that began with qualitative research followed by focus groups and other studies that augmented the variables.

Three scales composed the TRI. The coefficient alphas for the four subsets in the TRI range from .79 to .81 indicating an adequate level of reliability and validity for the instrument. The validity of the TR was scored across three scales including: (1) 36-item scale that measured four dimensions of optimism, innovativeness, discomfort and insecurity; (2) 10 item scale that measured the four dimensions and surveyed for responses regarding TR, and (3) 6 item scale that measured a few TR items but operated within a limited scope of questions. After consideration, the 10-item scale was selected for this survey (See Appendix A for 10-item scale).

Ten-Item TRI Scale

This study used the 10-Item TRI Scale consisting of 10 questions culled from the 36-item TRI. Based on observations presented by Barnhart and Ratchford (2007) regarding response fatigue and acquiescence bias, the decision was made to use the 10-point scale (Parasuraman & Colby, 2001) with the expectation that fewer questions

would increase the number of responses. Frequency of response was a consideration for use of a survey instrument disseminated over the Internet using by Survey Monkey software. The reliability of the 10-item scale was .77 when validated with a representative sample of 590 cases, unweighted. This was acceptable given the minimum acceptability of .7 for reliability (Rockbridge Associates, 2009).

The TRI 10 item scale assesses positive and negative feelings and paradoxical feelings that respondents have towards technology. Respondents were asked questions based on the 4 domains of the TRI to include: (a) optimism, (b) innovativeness, (c) discomfort, and (d) insecurity. Responses to the 10 item scale provided data to measure the attitudes of the sample populations in four main domains. For example, to obtain reactions to optimism, respondents were asked how strongly they agreed or disagreed with statements like: whether or not they find technology mentally stimulating; whether they like computers that allow them to tailor to their own needs; how they like to do business via computers; and whether technology makes them more efficient in their occupations.

To determine 'innovativeness' the TRI posed questions to respondents to indicate whether they strongly agreed or disagreed that people come to them for advice on new technologies; whether they are the first among their friends to acquire new technology; whether they keep up with the latest technologies developments, etc. To measure 'insecurity,' the TRI inquired into how individuals felt when doing business with a company that incorporate technology such as ecommerce; whether they felt safe giving out a credit card over a computer; and whether they worried about their information being

sent over the Internet and being seen by other people. These questions addressed the paradox of positive and negative feelings that individuals may have towards technology.

In the fourth area of inquiry, the TRI survey addressed 'discomfort' levels among individual respondents. Individuals were asked to strongly agree or disagree with a series of questions regarding whether they felt technical support provided was not helpful because technical people did not explain details clearly; whether there should be caution in replacing people with technology because technology could break down or get disconnected; and whether technology always seemed to fail at the worse possible time. Data obtained from this study described the major characteristics of health professionals regarding their positive or negative TR to determine if health professionals were explorers, pioneers, skeptics, paranoids, or laggards regarding their acceptance of technology. The demographic data was analyzed to determine if respondents from different geographic regions fell into one category over another; whether male respondents were different from females; and whether specific health careers dictated the characteristics of respondents.

Sample Size

Seventy-two individuals responded from the sampling frame to the survey establishing a sample size of 72. A post hoc analysis calculated the g-power of the sample size and results are presented in Chapter 4.

Survey Strategy and Data Collection

The 10 questions of the TRI instrument were formatted in Survey Monkey, an on-line software system used to distribute, collect, and compile data. Survey participants

were asked to respond to each question using a Likert Scale standard to evaluate responses of strongly agree, somewhat agree, neutral, somewhat disagree and strongly disagree. Questions were included in the survey for respondents to describe their demographics including occupation, geographic location, age, gender, race, and any comments they wished to provide. There were not any incentives were offered and respondents were notified that they would receive results.

The random sample of health professionals selected for this study were identified with a probability sampling design. While this study does not claim to produce results applicable to all health professionals, it examined the TR of a heterogeneous sample of individuals who worked in various occupations in the health sector. Further research with a larger sample would be required to produce generalizations applicable to health professionals in general—a workforce consisting of millions of workers.

Consistent with probability sampling, all cases in the sample were randomly selected with a known probability of being included (Singleton, Royce, 2005). The target population was from a database of 1,000 individuals compiled from sign-in lists at health conferences and workshops attended by diversity and homogeneous populations of self-defined health professionals. Individuals were contacted by email and invited to participate. They received a cover letter that described the current public policy environment promoting HIT along with the need for health professionals to contribute to the body of knowledge regarding their own TR. Respondents were asked to provide their email addresses if they wished to receive results of the survey when available and were

assured their names and emails were maintained in a confidential database. Consent forms for electronic signature were attached to the request.

Methods of Data Analysis

Results of this study were analysis using *t* tests, means analysis and ANOVA. A series of descriptive tables provide additional information regarding responses to the TRI. Differences among the sample were evaluated to compare and contrast responses based on the 4 domains/variables used in the study. ANOVA tests determined differences and correlations among the demographic groups in the study regarding positive or negative TR and acceptance or rejection of the null hypothesis.

Data showed the means per variable with skewed distributions that enabled analysis determining if the correlation of variables to overall TR was positive or negative based findings from the survey. Descriptive statistical analysis described the predisposition of the sample of health professionals regarding acceptance or rejection of new technologies based on their scores and the relationship of the four variables, as measured by the TRI. Data were presented in tables to report frequency scales, quantitative descriptive statistics, summary of categorical variables and inferential statistics based on one-sample T-Tests. There were also ANOVA tests conducted and a Pearson Product Moment Correlation test. Ordinal scales presented descriptive analysis of the means and standard deviations for each question.

Protection of Participants' Rights

When the sampling frame health professionals were contacted for participation in the survey, they were provided with the consent forms and notified regarding their rights.

They were provided with information regarding how to contact a representative at Walden University if necessary and provided with contact information for the researcher. Participants were asked to provide consent to use their data and those who wished to receive copies of the results were invited to provide email addresses. No data were collected and no participants were contacted for this study until it was approved by the university Institutional Review Board with approval # 1-012010-0328722. All survey data was compiled by the survey software for download onto a secure hard drive and external hard drives were kept by the researcher in secure locations.

Chapter 4: Presentation and Analysis of Results

This chapter reports on data compiled from the field research and tests hypotheses presented in the study. The objective of this section is to examine the theoretical interplay between the concept of TR and evidence collected from the survey sample (Singleton & Straits, 2004). This section presents statistical relationships of participant responses in tables showing the test mean results of the TR contributor and inhibitor variables of optimism, innovativeness, insecurity and discomfort. Results are presented in frequency tables, means tests, correlation scales, and descriptive analysis. The chapter concludes with discussion regarding inferences found in the data, comparisons, and contrasts of the findings, conclusions, and ethical management of the data. A copy of the 10-question TRI survey is included in Appendix A.

Review of Research Strategy and Hypothesis

The TRI survey instrument was distributed to individuals in the database by email. Respondents completed the survey on-line and provided electronic signatures for authorization to use their data for academic purposes. Responses were collected by survey monkey and reported by question, age, gender, geographic region, race, and health profession. Review of the 4 hypothesis are:

$H_0$1: Positive TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and optimism.

H_A2: Positive TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and innovativeness.

$H_0$2: Positive TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and innovativeness.

H_A3: Negative TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and discomfort.

$H_0$3: Negative TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and discomfort.

H_A4 Negative TR of health professionals, as measured by the TRI, is dependent on the perception of health professionals regarding technology and insecurity.

$H_0$4 Negative TR of health professionals, as measured by the TRI, is independent of the perception of health professionals regarding technology and insecurity.

To restate the conceptual definitions of the variables in the study: Optimism and innovativeness were believed to contribute to positive TR, and discomfort and insecurity were believed to inhibit or suppress positive TR and to promote negative TR (Parasuraman & Colby, 2001).

Sample Size

An a priori power analysis determined the target sample size for the study. Analysis began with a definition of the population of interest by identifying the target population as health professionals. Establishing the target population was required to determine how to generalize results and provide a basis for determining which cases should be included in the survey sample (Singleton & Straits, 2004). Factors considered regarding the description of the sample included the following elements: (a) heterogeneity of the population, (b) desired precision, (c) type of sampling design, and

(d) available resources and (e) number of breakdowns planned in sample analysis (Singleton & Straits, 2004, p. 140).

The first element of heterogeneity among the participants in the sample was based on the self-declared occupations of the participants as health professionals consistent with description of health professions described by Burke and Weil (2005). Eligibility for the sample included employment in occupations in the health sector that incorporated technologies, including health and medical organizations, government agencies, non-profit and for-profit organizations. A sampling frame of 1,000 health professionals was operationalized as the universe for the survey sample (Singleton & Straits, 2005). A post-hoc analysis determined the second element of desired precision or confidence interval for the sample size based on a 95% confidence interval established within 5 points of error. For the 95% confidence interval, the sample mean was +/-5 points with the maximum error as the size of the confidence interval (Mirabella, 2010).

The sampling frame was representative of the target population and closely approximated the characteristics of health professionals (Singleton & Straits, 2005). Probability sampling based on random selection indicated each of the individuals had an equal chance of being selected for the survey. The mechanical on-line survey instrument was used to ensure that chance dictated the selection of respondents (Singleton & Straits, 2005). Individuals were contacted by email, invited to participate without incentives and provided with consent forms for electronic signature.

The text of the cover letter that included the consent form emphasized the current public policy environment that is promoting HIT with a statement of the need for health

professionals to contribute to the body of knowledge regarding use of technology. The available resource used for the sampling frame was a database composed of approximately 1,000 individuals who self-described as health professionals on sign-in sheets at conferences, workshops and from on-line forums. One limitation of the database was the majority of names were collected at national forums held in the District of Columbia and had the possibility of being limited geographically however, results indicated responses came from each of the federal regions including 25 states showing geographic dispersion.

The number of breakdowns in the sample analysis were based on the size of the sample, the number of variables and variable categories used in the study (Singleton & Straits, 2005). These variables included demographic information from the sample of 72 individuals that included gender, race, and age. Descriptive data determined if TR varied among the groups based on the variables cited.

Post-Hoc G-Power Analysis

A post hoc statistical g-power analysis determined the power of the sample size based on key specifications including effect size (Cohen, 1992). For this study, a large desired effect size was desirable to validate results from the survey beyond the immediate sample of individual health professionals that participated in the survey. The specifications used to determine the g-power included the sample size of 72, the 3 groups in the study, an alpha value of .05, large effect size of .40 and error probability of .05.

The g-power statistical test resulted in a power of .85. This value is higher than the power level than .80 recommended by Cohen (1992) for statistical studies. This level

of power supported a large effect size that enabled interpretation of findings to a target population of health professionals.

Data Analysis

This data analysis began with a statement of hypothesis and anticipated relationships of TR among a sample of individuals based on the literature. The TRI survey was used, and based on its established reliability, no data modification of the questions was applied. Consistent with data processing approaches, there was modification of the scale of responses in which two categories of 'don't know' and 'refuse to answer' were collapsed into one neutral category on the scale (Singleton & Straits, 2005 year). Following data collection responses were edited to ensure information was ready for transfer to the SPSS computer system used for analysis and production of matrix tables (Singleton & Straits, 2005).

Findings from the means tests led to the researcher's rejection of three of the four nulls based on the hypothesis that the sample of health professionals perceived dependent relationships between TR, as measured by the TRI and the variables of optimism, insecurity and discomfort. The null hypothesis for the variable of innovativeness was not rejected based on results to the survey indicating individuals in the sample did not perceive a dependent relationship between TR and innovativeness. Overall, findings indicated there was a perception of dependent relationships between TR and the attitudes and predispositions of the individuals in the study regarding optimism, discomfort, and insecurity, and there was not a relationship between TR and innovativeness.

The strongest relationship measured by the statistical analysis was regarding the TR contributor variable of optimism. Respondents indicated strong positive TR regarding optimism, found new technologies to be mentally stimulating, and liked computer programs to be tailored to meet their own needs. These positive findings were an indication of high TR regarding the variable of optimism. The overall mean for the second variable of innovativeness found an independent relationship between TR and innovativeness that showed mixed results within the domain. Respondents answered innovativeness questions positively and negatively a finding consistent with findings from Mick and Fournier (1998).

Respondents reported perceived relationships between negative TR and insecurity and negative TR and discomfort, leading the researcher to reject the null hypothesis that there were no relationships between TR and those variables. Low scores below the test mean found insecurity and discomfort acted as inhibitors to TR, and these findings were consistent with theories presented by Parasuraman and Colby (2001). The Pearson correlation tables found correlations between innovativeness and optimism but did not find positive correlations between optimism and insecurity or optimism and insecurity. Consistent with findings of the means tests the correlations analysis also found paradoxical or mixed feelings regarding innovativeness.

Data Management

Survey data in response to the 10-item TRI Index was compiled on a 7-item Likert ordinal scale with 5 as the value for strongly agree; 4 the value for agree; 3 the value for neutral; 2 the value for disagree; and 1 the value for strongly disagree. Values

for ‘don’t know’ and ‘refuse to answer’ were combined into the neutral category, thereby reducing the categories in the data compilation from 7 responses to 5 (Parasuraman & Colby, 2009). The test mean of 3 was used to establish positive and negative TR with positive TR indicated where the value was more than 3 or >3 and negative TR when the value was less than 3 or <3. Results of the TRI survey were organized into four study domains referred to as contributor and inhibitor variables including two contributor variables of optimism and innovativeness; and two inhibitor variables of insecurity and discomfort (Parasuraman & Colby 2001). The data from participant responses was compiled in Survey Monkey, downloaded into Excel files, uploaded into SPSS software and presented in a series of tables. The following section presents results of the tables organized in descriptive statistics, frequency tables, ANOVA, and Pearson correlations.

Presentation of Findings

The sample of health professionals was diverse in terms of age, gender, race, geographic region, and occupation and was evaluated by a g-power analysis to have a large sample effect. This section begins with a description of the states and regions of the country represented followed by race, age and gender frequencies. The next section of chapter four discusses descriptive statistics in the sample and includes ANOVA tables, Pearson Correlations, summaries and analysis of results.

Geographical distribution of sample

During a 5-day period, 72 individuals responded from 25 states including: Alabama, Arizona, California, District of Columbia, Florida, Georgia, Indiana, Illinois, Kansas, Louisiana, Maryland, Michigan, Missouri, Nevada, North Carolina, New

Mexico, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah and Virginia. Results from the study may be of interest to the federal government because the sample included 10 federal regions, and the diffusion of health technologies is nationwide. Additional research would determine if there are differences in TR based on geography within the United States. One of the limitations of the geographic sample is that it does not include results from the territories such as Virgin Islands and Guam.

Health Occupations

The sample included a range of occupational categories listed by the U.S. Department of Labor (2009). Participants in the study were identified as physicians, nurses, health educators, health administrators, informatics specialists, non profit health executives, pharmacists, and a range of other occupations. The diversity of occupations in the sample provided the study with an overview of perceptions from varying sectors that include use of HIT as part of their health sector occupations. Additional research would be needed to obtain information about the TR of specific occupations and such additional research could be used to compare and contrast one industry sector with another regarding the TR of individuals in those occupations.

Table 5

Occupations of Sample of Health Professionals in Survey

Answer Options	Response Percent	Response Count
Health Administrator/Manager	20.0%	11
Nurse	38.2%	21
Physician	12.7%	7
Surgeon	1.8%	1
Pharmacist	3.6%	2
Health Educator	10.9%	6
Informatics Specialist	3.6%	2
Non-Profit Health Executive	10.9%	6
Government Health Policy Executive	5.5%	3
Health Communications/Journalist	7.3%	4
Home Healthcare Worker/Caregiver	0.0%	0
Sub-Total		63
Other (please specify)		
Psychologist		1
Medical Specialty Society executive		1
Health scientist		1
Physician Assistant		1
Former International Health Policy Executive		1
Nurse practitioner in geriatrics		1
Registered Dietitian		1
Self employed healthcare consultant		1
Public Health Advisor		1
Total Other		9
	Total Answered Questions	72

Table created by S. Myers (2009)

Racial, Age and Gender Frequencies

Respondents marked their racial categories on the survey. Responses were White/Caucasian 51.6%, Black/African American 41.9%, Black/Caribbean or African 4.8%, Latino/Hispanic 3.2%, and Asian American 1.6%. Participants' comments regarding ethnicity definitions included Asian and White; Native American; Mixed Race; African-Kenyan; just a person; ethnicity should not matter not a valid variable; Racially, I'm considered white ethnically, I am Hispanic--this question is worded wrong; and mixed. The gender of the participants was 22.5% male and 77.5% female. Ages of the participants were: 1.4% between the ages of 18-25 years; 21.1% between the ages of 25-40 years; 16.9% between the ages of 40-50; 38% between the ages of 50-60 years and 22.5% older than 60 years. (Appendix D includes demographic questions)

Descriptive Data Results

This section presents descriptive statistics of the data collected in the study that organized and summarized the data showing relationships among the variables (Singleton & Straits 2005). A test mean statistic of 3 was established to aid with interpretation of results based on the median value of the Likert scale of 5 ordinal measurements in the survey. Values in the descriptive data tables that were more than 3 were equated to positive TR and values less than 3 were equated to negative TR. The category of neutral on the scale included collapse of the two categories of responses of "don't know" and "refuse to answer."

Table 6

Descriptive Statistics of Individual Questions in TRI

	N	Minimum	Maximum	Mean	Std. Deviation
Optimism					
Q1	72	2	5	4.29	.777
Q3	72	2	5	4.42	.783
Innovativeness					
Q5	72	1	5	3.17	1.267
Q7	72	1	5	3.26	1.332
Q9	72	1	5	1.87	1.074
Insecurity					
Q2	72	1	5	2.63	1.283
Q4	72	1	5	2.13	1.174
Q6	72	1	5	3.49	1.075
Discomfort					
Q8	72	1	5	2.72	1.281
Q10	72	1	5	2.26	1.187
Valid N (listwise)	72				

Notes: Optimism responses for Q1 & Q3 were >3 indicating dependent relationship between TR and optimism; Innovativeness responses for Q5 & Q7 were >3 indicating positive TR however, responses to Q9 were <3 indicating negative TR therefore showing mixed result for innovativeness; Responses to Insecurity for Q2 & Q4 were < 3 indicating negative TR while response to Q6 was >3 indicating positive TR and mixed results; Responses to discomfort for Q8 & Q10 were <3 indicating perceived dependent relationships between negative TR and discomfort.

Table 7

Descriptive Statistics of Overall Means of 4 TR Domains

	N	Minimum	Maximum	Mean	Std. Deviation
Optimism	72	2.00	5.00	4.35	.596
Innovativeness	72	1.00	5.00	2.77	.859
Insecurity	72	1.00	4.67	2.75	.808
Discomfort	72	1.00	4.00	2.49	.854
Valid N (listwise)	72				

Notes: The means test results for optimism was 4.35 rejecting the null and indicating a perceived positive and dependent relationship between TR and optimism. For innovativeness, the mean was 2.77 indicating acceptance of the null and a perceived negative and independent relationship between TR and innovativeness. For insecurity, the mean was 2.75 rejecting the null and indicating a perceived negative and dependent relationship between TR and insecurity. For discomfort, the mean was 2.49 indicating rejection of the null and a perceived negative dependent relationship between TR and discomfort.

Table 8

Pearson's Correlation of 4 Variables of Technology Readiness

Correlations

		Optimism	Innovative	Insecurity	Discomfort	Avg
Optimism	Pearson Correlation	1	.612**	.005	.351**	.660**
	Sig. (2-tailed)		.001	.969	.003	.001
	N	72	72	72	72	72
Innovative	Pearson Correlation	.612**	1	.009	.459**	.803**
	Sig. (2-tailed)	.001		.943	.001	.001
	N	72	72	72	72	72
Insecurity	Pearson Correlation	.005	.009	1	-.003	.478**
	Sig. (2-tailed)	.969	.943		.983	.001
	N	72	72	72	72	72
Discomfort	Pearson Correlation	.351**	.459**	-.003	1	.645**
	Sig. (2-tailed)	.003	.001	.983		.001
	N	72	72	72	72	72
Avg	Pearson Correlation	.660**	.803**	.478**	.645**	1
	Sig. (2-tailed)	.001	.001	.001	.001	
	N	72	72	72	72	72

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

Notes: Sig values less than the alpha of .01 indicated a statistically significant correlation between the variables of optimism and innovativeness and optimism and discomfort. These findings indicated individuals in the sample had similar perceived attitudes about both sets of variables. Adjustments to optimism could affect innovativeness and adjustments to optimism could affect discomfort providing an indication of how to modify variables by changing dependent variables.

Table 9

ANOVA Table on - Age and TR

		Sum of Squares	Df	Mean Square	F	Sig.
Optimism	Between Groups	1.509	3	.503	1.416	.246
	Within Groups	23.452	66	.355		
	Total	24.961	69			
Innovative	Between Groups	1.208	3	.403	.542	.655
	Within Groups	49.053	66	.743		
	Total	50.260	69			
Insecurity	Between Groups	4.896	3	1.632	2.636	.057
	Within Groups	40.864	66	.619		
	Total	45.760	69			
Discomfort	Between Groups	1.807	3	.602	.804	.496
	Within Groups	49.439	66	.749		
	Total	51.246	69			

Notes: The ANOVA test showed that all of the age groups in the sample had the same degrees of freedom for the 4 variables. There were 3 df between the groups and 66 df within the groups. These results indicated no significant differences among age groups regarding their perceived TR and optimism, innovativeness, insecurity and discomfort.

Table 10

ANOVA Table on Race and TR

		Sum of Squares	df	Mean Square	F	Sig.
Optimism	Between Groups	.111	2	.055	.152	.859
	Within Groups	25.108	69	.364		
	Total	25.219	71			
Innovativeness	Between Groups	.267	2	.134	.177	.838
	Within Groups	52.097	69	.755		
	Total	52.364	71			
Insecurity	Between Groups	2.211	2	1.106	1.729	.185
	Within Groups	44.121	69	.639		
	Total	46.332	71			
Discomfort	Between Groups	.110	2	.055	.074	.929
	Within Groups	51.636	69	.748		
	Total	51.747	71			

Notes: All racial groups responded to TR based on df=2 between groups and df=69 within groups for each of the 4 variables, showing no distinction in TR based on race. Insecurity had a significance of .185 or less than the alpha value of .5 indicating insecurity regarding TR. More research is required to further define how insecurity and TR is perceived among racial groups.

Table 11

T-Test: Descriptive Statistics Regarding Gender

Group Statistics Regarding Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Optimism	Male	16	4.59	.58363	.14591
	Female	55	4.29	.59075	.07966
Innovativeness	Male	16	3.10	.60515	.15129
	Female	55	2.67	.90833	.12248
Insecurity	Male	16	2.46	.52880	.13220
	Female	55	2.84	.85792	.11568
Discomfort	Male	16	2.72	.60467	.15117
	Female	55	2.42	.91167	.12293

Notes: Results between males and females were similar for optimism and discomfort. For innovativeness males indicated higher levels of positive technology readiness than the females with females scoring less than the test mean of 3. Among the 55 women and 16 men in the sample differences were also found in innovativeness where men scored higher in technology readiness. This addressed the area of an individual's regarding willingness to be the first to use new technologies.

Table 12

T-Test Regarding Equality of Means for Gender

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Optimism	1.809	69	.075	.30	.16736	-.03104	.63672
Innovative	1.783	69	.079	.43	.24191	-.05115	.91403
Insecurity							
	-2.186	40.216	.035	-.38	.17567	-.73907	-.02911
Discomfort							
	1.543	36.914	.131	.30	.19484	-.09425	.69539

Correlation is significant at the .05 level.

Notes: This table expands on information regarding gender differences presented in Table 11. Based on the alpha value of .05 the variable of insecurity is significant at .035 indicating a difference among males and females with females registering a higher level of insecurity.

Table 13

Descriptive Analysis of Participant Responses to Question 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	3	4.2	4.2	4.2
	Neutral	5	6.9	6.9	11.1
	Somewhat Agree	32	44.4	44.4	55.6
	Strongly Agree	32	44.4	44.4	100.0
	Total	72	100.0	100.0	

Notes: Question #1 was an optimism question where participants were asked if they found new technologies to be mentally stimulating. Results showed 88% of participants responded they found technologies to be mentally stimulating and almost 90% of them said they liked computer programs tailored to their own needs. Responses were consistent across age, race and gender categories. Participant's comments: (a) yes, technologies are mentally stimulating and it can be negative or positive stimulation; (b) New technologies are stimulating only to the extent I see value added; (c) they can be mentally frustrating until they are mastered by the operator; (d) you have not operationally defined new technologies however, if you are referring to Facebook, MySpace, Twitter, I don't engage. I receive e-mail via lap tops, desk versions, and phone; (e) the amount of time I must invest to learn the application determines how much I will use it; (f) access to new technology in my workplace is not always available as in my home setting. I spend most of my time in the workplace to be mentally stimulated.

Table 14

Descriptive Analysis of Participant Responses to Question # 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	18	25.0	25.0	25.0
	Somewhat Disagree	20	27.8	27.8	52.8
	Neutral	8	11.1	11.1	63.9
	Somewhat Agree	23	31.9	31.9	95.8
	Strongly Agree	3	4.2	4.2	100.0
	Total	72	100.0	100.0	

Notes: Question 2 is an insecurity question where participants were asked if they provided information to a machine or over the Internet, they could not be sure it would get to the right place. Approximately 35% of respondents agreed that they were not sure it would get to the right place while 42% believed that is would. Participants commented: (a) I am certain that most times, information will get to the desired location; (b) I know it will get to the correct location but will also go to other unintended locations.

Table 15

Descriptive Analysis of Participant Responses to Question # 3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	3	4.2	4.2	4.2
	Neutral	4	5.6	5.6	9.7
	Somewhat Agree	25	34.7	34.7	44.4
	Strongly Agree	40	55.6	55.6	100.0
	Total	72	100.0	100.0	

Notes: Question 3 asked if participants liked computer programs that allowed them to tailor things to fit their own need. It was an optimism question and over 90% of respondents agreed that they like tailored programs. Only 4.2% indicated that they did not like programs tailored to their need. Some of the comments were: (a) No two individuals or any at all think or do activities in the same manner; (b) The expertise required to do the modifications determines how much I am able to use it. (c) More convenient and saves time; (d) I am not computer savvy...so I need support in these areas.

Table 16

Descriptive Analysis of Participant Responses to Questions # 4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	28	38.9	38.9	38.9
	Somewhat Disagree	23	31.9	31.9	70.8
	Neutral	6	8.3	8.3	79.2
	Somewhat Agree	14	19.4	19.4	98.6
	Strongly Agree	1	1.4	1.4	100.0
	Total	72	100.0	100.0	

Notes: Participants were asked if they considered it safe to do business online. This insecurity question prompted responds from 20% of the participants who indicated they did believe it was safe however, 70.8% percent indicated that they did not consider it safe to do business on-line indicating negative TR. Comments from participants included: (a) There are scanners and your ID can be stolen by a highly technological computer user; (b) As long as the network is secure and you are dealing with a reputable agency I feel safe; (c) If the site is secured as claimed by the vendor, financial business done online can save much time. (d) I do no online financial business; (e) depending on the institution I am doing business with I do not order products on line except books.

Table 17

Descriptive Analysis of Participant Responses to Question # 5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	11	15.3	15.3	15.3
	Somewhat Disagree	10	13.9	13.9	29.2
	Neutral	16	22.2	22.2	51.4
	Somewhat Agree	26	36.1	36.1	87.5
	Strongly Agree	9	12.5	12.5	100.0
	Total	72	100.0	100.0	

Notes: This innovativeness question asked participants if other people came to them for advice on new technologies. Almost a majority of them or 48.6 % indicated that other people did come to them for advice on new technologies while 29.2% said people did not come to them. This response would indicate that others regard the health professionals in the sample as opinion leaders and look to them for advice.

Table 18

Descriptive Analysis of Participant Responses to Question # 6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	4.2	4.2	4.2
	Somewhat Disagree	14	19.4	19.4	23.6
	Neutral	9	12.5	12.5	36.1
	Somewhat Agree	37	51.4	51.4	87.5
	Strongly Agree	9	12.5	12.5	100.0
	Total	72	100.0	100.0	

Notes: Participants were asked if they worried that information they sent over the Internet would be seen by other people. This insecurity question received responses from 77.9% that said they were worried their information would be seen by others. This is an indication of negative TR and concerns that information is not secure. Comments from participants included: (a) Yes, because many computer system can be compromised; (b) depends on the circumstances; (c) I can not say that I "worry" about it. But I am aware of the possibility. As a result, I am mindful of what I send via the internet; (d) there is no full proof security with the internet; (e) I'm fairly certain it will be seen, but don't really worry a great deal about it.

Table 19

Descriptive Analysis of Participant Responses for Question # 7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	9.7	9.7	9.7
	Somewhat Disagree	19	26.4	26.4	36.1
	Neutral	10	13.9	13.9	50.0
	Somewhat Agree	20	27.8	27.8	77.8
	Strongly Agree	16	22.2	22.2	100.0
	Total	72	100.0	100.0	

Notes: Question 7 asked participants if they could usually figure out new high-tech products and services without help from others. It was an innovativeness question and 50% of the participants responded that they could usually figure out new high products without assistance. Thirty-six percent said they could not. These responses indicated a positive TR regarding the capacity of the participants to manage new products themselves. Comments from participants included: (a) I am somewhat doubtful that I am applying the method as needed; (b) Occasionally, I have to reach out for tech assistance.

Table 20

Descriptive Analysis of Participant Responses for Question # 8

		Frequency	Percent
Valid	Strongly Disagree	14	19.4
	Somewhat Disagree	22	30.6
	Neutral	13	18.1
	Somewhat Agree	16	22.2
	Strongly Agree	7	9.7
	Total	72	100.0

Notes: Participants were asked if when they received technical support from a provider of a high-tech product or service if they felt they were sometimes being taken advantage of. This discomfort question found that the majority of respondents felt that they were not taken advantage of by technical service providers when they received technical support. There were no comments from participants.

Table 21

Descriptive Analysis of Participant Responses for Question # 9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	34	47.2	47.2	47.2
	Somewhat Disagree	23	31.9	31.9	79.2
	Neutral	7	9.7	9.7	88.9
	Somewhat Agree	6	8.3	8.3	97.2
	Strongly Agree	2	2.8	2.8	100.0
	Total	72	100.0	100.0	

Notes: This innovativeness question asked respondents if they were the first in their circle to acquire new technologies when they appeared. A strong response of 79.1% indicated that they were not the first to acquire new technologies. Comments suggested could the reason could be inability to purchase new technologies, lack of incentives of a range of other reasons. Comments from participants said: (a) When I can afford it! (b) If subscribed to a tech provider.

Table 22

Descriptive Analysis of Participant Responses for Question # 10

		Frequency	Percent
Valid	Strongly Disagree	25	34.7
	Somewhat Disagree	19	26.4
	Neutral	14	19.4
	Somewhat Agree	12	16.7
	Strongly Agree	2	2.8
	Total	72	100.0

Notes: Question # 10 is a discomfort question that asks if it is embarrassing when participants have trouble with high-tech gadgets while people were watching. Participants responded by 52.1% that they were not embarrassed when people watched them with high tech products. This was a mixed result where 28.9% indicated they were either embarrassed or neutral on the subject. There were no comments for this question.

Data Analysis

The statistical tests for this study found the sample of health professional failed to accept the null hypothesis for 3 of the 4 variables included in the TRI survey. Respondents rejected the null hypothesis for optimism, insecurity and discomfort and indicated that they perceived there was a dependent relationship between TR and those three variables. These results were based on descriptive statistical tests of overall means and a Pearson's Correlation test that showed participants did not accept the null hypothesis there was a perceived independent relationship between TR and the variables of optimism, insecurity and discomfort. Instead, they believed there were dependent relationships between TR and those variables. Findings supported the null hypothesis that there was a dependent relationship between TR and the predisposition of the sample of health professionals towards innovativeness. Inferential analysis based on a g-power of .85 of the sample and a large effect size suggested similar results would be found among the target population of health professionals regarding TR and the 4 variables.

The diverse sample of health administrators, physicians, nurses, pharmacists, health educators, informatics specialists and non-profit health executives measured high in optimism based on analysis of test results from the average means tests. The sample was predominately women and 60% were over the age of 50 years indicating a mature workforce of health professionals who were optimistic about using new technologies and felt mentally stimulated. This diverse sample provides insight into the attitudes and beliefs of older, mostly female health professionals who are examples of the type of people who have already experience some technologies in healthcare and will most likely

experience additional technologies as results of federal efforts to increase diffusion of innovation into the healthcare industry. Eighty-eight percent of individuals reported they were optimistic about technology indicating a positive and high level of level of TR and 65% percent of the individuals responded positively when asked if they liked to tailor technology programs to meet their own needs indicating a positive TR and level of confidence regarding use of technology.

The null hypothesis was accepted for the variable of innovativeness indicating individuals in the sample perceived an independent relationship between TR and innovativeness. It is important to note that the results of the means tests for the variable of innovativeness were mixed. Individuals responded with values of more than the test mean of 3 for 2 of the 3 innovativeness questions however, the overall average of means for the innovativeness questions was less then 3 and therefore accepted the null hypothesis that there was a perception of independence between TR and innovativeness. This mixed finding was consistent with theories presented by Mick and Fournier (1998) that individuals could have paradoxical attitudes towards technology that were positive and negative at the same time (1998). The variables of insecurity and discomfort were found to be inhibitors of TR with the average mean less than the test mean of 3, indicating negative TR for those variables.

Descriptive tables indicate that 48% of the respondents indicated people did come to them for help indicating that the sample of health professional were perceived as opinion leaders by others. When asked if they were the first to get new technologies 79.1% said they were not—an indication that the individuals in the sample were not

innovators, explorers or early adopters (Parasuraman & Colby, 2001, Rogers, 2003). This negative TR response regarding gaining new technologies should be of concern to those in the health sector who are responsible for successful diffusion of new technologies to individuals who, if they are similar to the sample might not be among the first to adopt them.

Regarding the variable of insecurity and TR there was a range of responses in the sample with 52% indicating confidence that information gets to the right place and 32% believing that it might not. Regarding whether it is safe to do financial transactions on-line over 70 % indicated it was and 63 % worried that others would see information sent over the Internet. An independent sample t-test showed a difference between groups regarding insecurity with a significance of .035 that was less than the alpha of .05 and indicated significant levels of TR and insecurity among the groups.

ANOVA tables did not show any differences among groups based on age and race with degrees of freedom among the groups scoring the same for each variable per category. Exacting the same degree of freedom scores indicated no significant differences in TR among groups based on age and race. Results from pearson's correlation tests indicated significant positive correlations of .001 among the sample of health professionals between optimism and innovativeness and significant positive correlation of .001 regarding optimism and discomfort. The significance values were less than the alpha of .01 indicating a relationship between TR and the sets of variables. Further study may find that adjustments to optimism could affect innovativeness and adjustments to

optimism could affect discomfort therefore providing indications of how to modify TR variables positively by changing the dependent variables.

Ethical Management of Data

Participants received consent forms that they agreed to sign as part of the survey and were offered results of the survey. Respondents provided consent by email with their names and email addresses. Individual participant information was stored in a secure location and was not made available to anyone outside of the author. Upon completion of the dissertation, each individual who requested results will receive them by email and there will be no disclosure of names of participants.

Consistencies, Inconsistencies and Limitations

The spread of responses showed an overall negative relationship between TR and innovativeness although the average mean for 2 of the innovativeness questions was positive. However, question 9-- an innovativeness question asked if individuals were the first in their group to use new technologies and their response was very low resulting in the innovativeness variable accepting the null and showing an independent relationship between TR and innovativeness. The mixed results for the innovativeness question and the poor response to the question about using new technologies indicates the individuals were not venturesome or explorers regarding new technologies. One limitation was no additional data was collected regarding the elements that contributed to their unwillingness to be the first to try innovations even though they rated high in optimism. The mixed response shows the importance of educating health professionals that it is possible to be attracted to and repulsed by technology at the same time.

A second limitation was the deficit of young health professionals in the sample. Future research should expand the sample of young health professionals to determine if the age group would show greater difference among groups than was shown in this sample of health professionals. If there are significant differences measured among younger health professionals regarding innovativeness and their willingness to try new technologies there may be opportunities for intergenerational training where younger groups of health professionals assist older groups with trying new technologies.

A third limitation was the effect of the design of the TRI as an ordinal scale on the capacity to conduct a correlation analysis. The ordinal scale of 1-5 that measures technology readiness did not provide variables that could be easily correlated to the 4 variables of optimism, innovativeness, insecurity and discomfort. Ratios were used with a Pearson's correlation to show relationships with the 4 variables.

Chapter 5: Theory, Conclusion and Social Change

Significance of Study

During the first decade of the 21st century, the status of the health sector in the United States emerged as a significant and costly national issue. During 2009-10, when this study was conducted, national events connected issues regarding access and quality of health care to diffusion of new technologies. First, the federal government established a priority on fostering the spread of technologies into the health system through the U.S. Department of Health and Human Services by providing millions of dollars of funding to States, agencies and non-profits to promote the use of health information technologies (U.S. Department of Health and Human Services, 2010). Second, in early 2010, the U.S. Department of Commerce provided funding for $63 million to expand broadband technology infrastructure and some of the grant recipients were health clinics, hospitals, non-profit health service providers and telemedicine centers (U.S. Department of Commerce, 2010).

All of the health-related projects funded by the federal agencies required involvement from health professionals in some capacity, and their acceptance or rejection of new technologies could be instrumental in the success and/or failure of funded projects. In addition, during 2009, the White House and U.S. Congress debated proposed health legislation, known as H.R. 3200, to sponsor health reform measures that included initiatives to diffuse health technologies to improve efficiencies, reduce errors and promote the use of electronic medical records (Library of Congress, 2010).

The combination of federal actions combined with research and development of new health innovations made the preparation and training of health professionals a critical issue. To the extent there were tools to measure and evaluate the preparedness of the health professional workforce to assume new responsibilities that involved technologies, there would be capacity for health professionals to keep pace with change. However, there could be consequences if health professionals do not master emerging innovations such as electronic medical record-keeping, remote radiological analysis, robotic surgeries, nursing home sensors, monitoring, and other innovations.

As national needs for healthcare increase due to an expanding population of aging baby boomers, the need for qualified health professionals who are competent with health technologies will also increase. Findings from this study provide relationships between theory and data based on interpretation of results of the survey based on scholarly theories. This knowledge could be helpful for curriculum, training and continuing education for the health professional workforce.

Interpretation of Findings

Outcomes of this study indicated mixed news for health professionals and decision-makers who hoped to influence positive acceptance of technologies. The high responses in optimism and several parts of innovativeness indicated positive TR regarding those contributor variables. However, paradoxical attitudes were found in the sample regarding the reluctance of individuals to be the first to try out new technologies.

A number of theories presented by scholars expressed concerns about the impact of the rapid diffusion of technology into society. They referred to paradoxical attitudes

among users of technology, potential societal disruption and the potential of incentives to promote use of technologies. This section connects six theoretical constructs from the literature with data from the study to include: (a) health professionals as opinion leaders (Rogers 2003); (b) incentives and health professionals (Parasuraman & Colby 2001); (c) guiding cultural change among health professionals regarding new technologies (Spicer 1952); (d) recognizing potential "lack of fit" among health professionals and technology (Kuhn 1962); (e) Unintended Consequences in Advancing Health Technologies (Wejnert 2002); and (f) Paradoxes Among Users of Technology (Mick & Fournier 1998).

Health Professionals as Opinion Leaders

Rogers (2003) emphasized the important role that opinion leaders played in the diffusion of technologies in society. He observed that opinion leaders were well traveled, accessible, had higher economic status than others and belonged to organizations and networks. The qualities of opinion leaders that Rogers referred to are were characteristics that many health professionals share. In the Health Professionals TRI Survey more than 87% of the responses indicated that others come to them for help with technologies—underscoring their role as opinion leaders. The role of health professionals as opinion leaders may have a use beyond the health profession when there are efforts to diffuse technologies into other areas of society.

Incentives and Health Professionals

Parasuraman and Colby (2001) identified 4 areas in the marketing industry where incentives are used to promote new technologies—technology evangelism, future-ready design, proving benefits and market-stage pricing. These strategies are discussed in detail

in Chapter 3 and may prove relevant to encourage health professionals to be more willing to be "first movers" regarding obtaining new technologies. Survey results found that the sample respondents were innovative in other areas, but were reluctant regarding being the first in their group to obtain new technologies. Incentives with pricing, emotional appeals and/or gifts of new technologies may improve the willingness of individuals with these attitudes to try the newest technologies in the marketplace. The sample rated high in optimism indicating high and positive TR that could possibility be enhanced by incentives.

Guiding Cultural Change Regarding New Technologies

Health professionals in the sample showed insecurities and discomfort in a number of areas, indicating they were nervous and uncomfortable about whether information gets to the right place, Each demographic group in the study responded similarly to the same questions, regardless of gender, race or age. Spicer's (1952) admonitions to be conscious of the cultural implications of technology are relevant for this set of results.

In addition, mean scores indicated demographic groups in the sample responded with similar levels of insecurity and discomfort regarding embarrassment when they were watched with new gadgets and they had concerns about whether information gets to the right place. To respond to these findings, there could be efforts to improve positive TR regarding in insecurity and discomfort. During a period of rapid diffusion of technology when health professionals are regularly confronted with new technology applications and equipment, there may be benefits to applying Spicer's (1952) model of guiding cultural

change by first identifying the compelling need for the technology, appraising the situation, finding causes of success and failure among those groups and then producing change. Spicer's model would be in contrast to approaches that first institute rapid policy and administrative changes then later identify compelling needs and find causes of success or failure.

Recognizing Potential Lack of Fit Among Health Professionals and Technology

When new technologies prompt a paradigm shift in society, this can result in resistance, lack of fit, and potentially lead to crisis in a society (Kuhn, 1962). There are 3 steps in paradigm shifts that include blurring the paradigm, loosening the rules regarding existing paradigms, and conducting research in a narrower scope to make room for the emerging data. According to Kuhn, a battle for acceptance can occur between the old and the new and this could prove problematic in a field as critical as healthcare. Fortunately, the results of the survey showed strong optimism among the sample. If Kuhn's observations are shared among health professionals, then concerns about lack of fit may not be realized. However, if due to cost, efficiencies, resistance or other problems a lack of fit occurs in institutions rapidly deploying health technologies there may need to be interventions that recognize lack of fit has occurred and immediate steps may be needed to identify areas of change and gaps in the system.

Unintended Consequences in Advancing Technologies

Wejnert (2002) expressed concern that little regard had been given to conducting cost benefit analysis in the public sector when new technologies were introduced. She believed there should be an analysis of societal impact in order to identify and avoid unintended consequences. For example, the optimism and positive TR among the sample indicated overall receptivity to the introduction of new technologies in health. However, some technologies might produce unintended consequences such as telemedicine leading to reduction of face-to-face doctor/patient visits; or errors in remote analysis of medical charts leading to mistakes and misdiagnosis. Another unintended consequence could be the introduction of new technologies into an older workforce of physicians and nurses could result in massive retirements and reduction of the workforce. Wejnert suggested that those who rushed to introduce new technologies should be cautious about the massive change that could occur in society.

The results from the survey that showed the sample of health professionals reported insecurity and discomfort in certain areas, and reluctance to be the first to embrace new innovations were elements of negative TR that warrant further study. Like Wejnert, Spicer (1962) also expressed concerns that poorly managed introduction of new technologies into society could produce unintended consequences and even destroy societies. Given these concerns, it is prudent for health policymakers and leaders to ensure that the strategies for introduction of health technologies incorporate the elements discussed in this study to enhance positive TR and to avoid potential rejection of health technologies or reductions in the workforce due to early retirements. .

Paradoxes among Users of Technology.

The last construct that emerged from this study was knowledge about paradoxical attitudes toward technology discussed by Mick and Fournier (1998). They found individuals could have simultaneously conflicting positive and negative attitudes individuals regarding use of technology and were drawn to technology and afraid of it at the same time. This paradoxical behavior was relevant to findings of this study in several areas. First, the sample population of health professionals scored high in positive TR and optimism while at the same time they were hesitant to be among the first users of new technology and expressed insecurity and discomfort that their information would not get to the right place over the Internet. According to Mick and Fournier (1998) these types of paradoxical attitudes were common among consumers. It is reasonable to conclude that like consumers health professionals could have paradoxical attitudes and could be helpful for health professionals to know that it is common to experience paradoxical feelings about technology applications and that they could be optimistic about new technologies and fearful at the same time.

Overall, this study reported positive TR and optimism towards new technologies across the demographics of geography, age, gender and race. The findings were consistent with Parasuraman and Colby's findings that overall consumers were optimistic about new technologies (Parasuraman & Colby 2001). Given the reluctance of the sample of health professionals to try new technologies first as explorers and innovators there may need to be incentives, training, education, and assurances of ease of use that

may enhance the willingness of health professionals to try to new technologies and influence social networks.

Implications for Social Change

Knowledge of TR can produce social change in a number of segments of society-at-large and in the health sector in particular. Application of the concept of TR and use of TRI evaluation instruments should be standard component of strategies prior to the introduction of new technologies to designated health professional workforces. Evaluation and analysis of the attitudes of health professionals as they interface with new technologies can be useful to advance the diffusion of technologies in every aspect of healthcare through recognition of health professionals as TR opinion leaders.

As the healthcare sector continues to expand and change in response to worldwide aging populations and innovations, there will need to be identifiable TR pioneers, innovators, and explorers who are prepared and willing to be the first to use new technology applications. These individuals will have the potential to provide leadership in access and of quality care and will lead the way in social change through future experimentation and use of robotics, remote health technologies, infomatics, and a range of yet to be invented health applications. Based on the similar TR responses of the sample across gender, race and age demographics desireable social change through increased use of health technologies can be achieved in various parts of society. Social change through TR and greater use of technology can be achieved efficiently by employing diverse groups of health professionals from every age group, race, and gender.

Health professionals can individually contribute to social change by recognizing that their personal acceptance or rejection of new technologies can serve to expedite or block efforts societal efforts to introduce health technologies in the workplace and at home. Recognition of the health professionals as pioneers and innovators can also help to diffuse technology in sectors outside of health. For example, innovative, pioneering TR health professionals could be leaders in their communities in introducing technology innovations into non health sectors. There is also the opportunity to avoid digital divides in health and technology by collecting racial, gender and age elements early and monitoring those factors as use of TR and diffusion of technology increases. While this study did not find gaps in age, race or gender regarding TR early data collection and evaluation of emerging disparities or gaps should be determined early to avoid potential gaps in knowledge that could emerge among health professionals who receive TR training and those who do not receive training. In addition, efforts to track TR based on age, gender and race could help identify any cultural lack of fit issues early and paradoxes that may be unique to specific groups.

Recommendations for Further Study

One area for additional study is to determine the effect the diffusion of technology has on the retention and retirement of health professionals. As the health professional workforce becomes older, there is a need to determine if there is a correlation between increased use of technology in health and increased retirements and problems with retention. As part of that study, analysis of data should determine if positive TR beliefs with incentives could delay retirement and promote retention.

A second area of study could be the TR of younger health professionals. The sample of individuals between the ages of 18-25 was only 1.4% in this study, so there was no reliable data that described the TR of younger health professionals. Future TR research could determine if younger health professionals demonstrate higher levels of TR in innovativeness than older members of the health workforce. If younger workers have higher TR regarding their willingness to try new technologies, there could be the potential for intergenerational training between age groups that could address TR in innovativeness among older health professionals. Matching older physicians, nurses and other health professionals with younger technology-savvy health professionals could provide opportunities for intergenerational mentorship, technology knowledge transfer and new workplace models to assist older professionals with acceptance of medical and health technologies.

A third area for additional research would be study the influence health professionals have as opinion leaders in other segments of society. If health professionals are determined to be individuals of significant influence regarding acceptance of innovations in the workplace and local communities they could be instrumental in introducing non-health related innovations to other segments of society. Using health professionals as leaders to introduce innovations could be useful in education, transportation, energy, community planning, business and other areas. For example, a community seeking to promote home-based wind energy may find local acceptance improve if the first users are the health professionals in the community.

Conclusion

Overall, the results of this study found the TR attitudes of the sample of 72 diverse health professionals to be optimistic towards new technologies, paradoxical regarding innovativeness and somewhat insecure and uncomfortable regarding the safety of information on the Internet. The lack of differences among the sample based on gender, age and race indicated positive potential for federal policymakers seeking to expand health technologies society-wide. Based on these finding and the federal goals to increase diffusion of health technologies throughout society it is the conclusion of this study that there should be increased efforts among the federal government and health institutions to invest in ways to enhance positive TR among health professionals. Failure to study and understand the elements of TR among the large health professional workforce is risky in terms of wasted investment in new equipment, lack of training, loss of time, early retirements and poor retention. In extreme situations, poor introduction of innovation to health professionals with negative TR could disrupt an entire system of healthcare and produce a poor quality of health service delivery for communities.

Therefore, it would be sound policy for the federal government and health institutions to encourage TR analysis of all segments health professionals prior to the introduction of new technologies into their workplace. Based on findings from TR research, managers will have more knowledge about the positive and negative TR elements in their workforce and can address those elements with strategic training and staff development approaches. Given the role of the health professionals as a vital component of the national workforce, any efforts to assist them with developing positive TR should benefit society as a whole.

Optimistic, innovative health professionals who understand paradoxical attitudes are normal and apprehension is an element of TR can be better prepared for innovations and can serve as opinion leaders. Greater use of TR surveys, costs benefit analysis, evaluations and careful planning that collect data and knowledge about the progress of TR among health professionals will enhance the achievement of federal goals and help produce positive social change by improving the overall health system—a benefit for patients, health professionals and society.

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Appendix A: 10 Item TRI Scale

1. You find new technologies to be mentally stimulating. (optimism)
2. If you provide information to a machine or over the Internet, you can never be sure it really gets to the right place. (insecurity)
3. You like computer programs that allow you to tailor things to fit your own needs. (optimism)
4. You do not consider it safe to do any kind of financial business online. (insecurity)
5. Other people come to you for advice on new technologies. (innovativeness)
6. You worry that information you send over the Internet will be seen by other people. (insecurity)
7. You can usually figure out new high-tech products and services without help from others. (innovativeness)
8. When you get technical support from a provider of a high-tech product or service, you sometimes feel as if you are being taken advantage of by someone who knows more than you do. (discomfort)
9. In general, you are among the first in your circle of friends to acquire new technology when it appears. (innovativeness)
10. It is embarrassing when you have trouble with a high-tech gadget while people are watching. (discomfort)

Notes: These questions comprise the technology readiness index copyrighted by A. Parasuraman and Rockbridge Associates, Inc., 1999. This scale may be duplicated only with written permission from the authors." (See Appendix B for Authorization)

Appendix B: Authorization for Use of TRI

From: Charles Colby <CColby@rockresearch.com> [Edit Address Book]
To: "R.J. Myers Publishing & Consulting Co." <rjmpub@earthlink.net> ***Subject:*** RE: form for TRI
Date: Dec 2, 2009 6:18 PM
Attachments: TR Index List for Academic Subscribers.doc

Hello Stephanie,

I received your signed request to use the TR scale for academic research. We formally grant your permission to use this index for your study as outlined in your application. Attached is the list of items and instructions for use.

If you need any kind of paperwork from me, please send me what you want to sign and I will fax back. From my point of view, you are good to go.

Good luck! Regards,
Charles L. Colby President
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Appendix C: Consent Letter

Dear Health Professional,

You are invited to take part in a research study to determine the attitudes of health professionals towards new technologies. To participate, please read and sign the Informed Consent Form below.

Thank you.

INFORMED CONSENT. This form allows you to understand this study before deciding whether to take part in a 15 question survey that will take approximately 10 minutes. Please be advised that the information you provide will be kept confidential in a secure location by Stephanie Myers, Principal Investigator/Doctoral Candidate, Walden University. Your responses will not be used for any purposes outside of this academic research project designed to contribute to the body of knowledge regarding health professionals and technology readiness. If you wish to be notified of the results, please provide your email address below and you will be provided with details regarding how to obtain a free copy of the Results.

Your participation in this study is completely voluntary and no one at any health agency or institution or agency will treat you differently if you decide not to be in the study or change your mind during the survey. If you feel stressed during the survey you may stop at any time or skip any questions that you feel are too personal. There are no risks to you from participating in this survey.

If you have questions you may email "Stephanie Myers" <stephanie.myers@waldenu.edu>. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott, the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210 Walden University's approval number for this study is #1-01-2010-0328722 and expires on December 31, 2010.

Please indicate that you have read the above information and understand the study well enough to make a decision about your involvement. If you are willing to provide your consent, please insert your name below to agree to the terms described above. Please print or cut and paste this form for your records.

*Please Insert Your Name Below to Provide Consent. Print out or cut and paste this document for your records.

Name: _____

City/Town: _____

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Editor. Nutrition and HIV Information Guide, HIV/AIDS Administration, Government of the District of Columbia, 2003.

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