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**A TEST OF THE EXTENDED TECHNOLOGY ACCEPTANCE MODEL FOR
UNDERSTANDING THE INTERNET ADOPTION BEHAVIOR OF PHYSICIANS**

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DEDICATION

I dedicate my dissertation to my family both nuclear and extended. Thank you for your prayers, patience, and understanding as I pursued this earthly endeavor. Mom and dad thank you for teaching me that the race is not always given to the swift, but to she who endures to the end. To my family and friends, I thank each of you for your endurance - and I gladly share this blessing and accomplishment with all of you.

“I can do all things through Christ which strengtheneth me.”

Philippians 4:13

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ABSTRACT

Information technology (IT) has become pervasive in the healthcare industry. Many view the Internet as a strategic healthcare tool. The Medical Records Institute suggests that Internet-based health applications (IHA), for example, electronic health records, e-prescribing, and mobile health are the goals of most healthcare organizations (2002). The use of the Internet for electronic medical records, e-billing and patient scheduling can enable the health care industry to reduce its inefficiencies and errors in care delivery (HIMSS/IBM Leadership Survey, 2000). While the use of IT in healthcare has increased tremendously, key players, specifically physicians still have not fully embraced the valuable resource of the Internet.

Despite the purported advantages of IT investments in healthcare many doctors do not widely use Internet-based health applications in their clinical practices. Physicians often misunderstand the functions and full potential of the Internet (Wang & Song, 1997). Health & Health Care 2010 report that less than 5% of physicians use computers to record all clinical information for an average patient.

The present study examined physicians' intentions to adopt Internet-based health applications for use in their clinical practices. This research reports on the test-retest reliability of the extended Technology Acceptance Model -TAM2 (Venkatesh & Davis, 2000).

Data were collected from a survey of pediatricians to evaluate the effectiveness and appropriateness of the model in the medical environment. Results from the study indicate that TAM2 is appropriate but not completely applicable to the unique characteristic of physicians. The test-retest indicated reliable results with the exception of the result demonstrability construct. The results of multiple regression analyses indicated that perceived ease of use was not significant in predicting physicians' behavioral intentions in this study. As theorized the primary predictor variable perceived usefulness was a strong determinant of intention to use. Results indicate that physicians tend to be pragmatic in their IT acceptance decisions. Physicians focus more on the technology's usefulness rather than its ease of use.

This dissertation discusses the implications, limitations and presents possible explanations for the inconsistencies within the extended technology acceptance model when it is applied to a professional group not commonly examined in IS research.

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CHAPTER 1

INTRODUCTION

“Everything from interactive Internet communication and new computer networking capabilities to new medical instruments, diagnostic devices and human genome research will change the face of health care as we know it.”

-Ed Egger (2000)

We live in an era of rapid information technological advancement. Technology is the method by which science is used for practical purposes. For example, physicians are now able to conduct an electronic house call via telemedicine. Telemedicine gives the health care sector the ability to use centralized medical experts to provide care to patients in rural or remote areas, and for centralized physicians to speak and share images and other patient information with rural doctors through two-way visual and audio networks. The use of computer technology and information technology in health care and its delivery is called medical informatics, which began with the computerization of hospital administration tasks in the 1960's. Today the role of digital technology in medical care has expanded at an ever-increasing pace (Burke & Weill, 2000). As a result, health care professionals' familiarity with telemedicine and medical informatics as well as the adoption of information technology is crucial, for the delivery of higher quality care. However, there is a clear lack of information technology (IT) use among physicians. The challenges of applying IT to health care are very real. Concerns of privacy and confidentiality of data, lack of national standards for protecting medical data, the need for large scale investments and the requirement for behavioral adaptations on the part of patients, physicians and organizations are just a few of the impediments to the adoption and use of IT in health care.

We begin this dissertation by presenting the phenomenon of information technology adoption within the general context of high quality health care delivery in the next section. The growing importance and vital roles of computers and Internet technology in today's health care environment present both promise and challenges for physicians.

Understanding physicians' adoption of information technology motivates the research problem considered in this dissertation. In sections 1.2, 1.3, and 1.4, respectively we address the research problem, present the research objectives and questions and subsequently present a guide to the dissertation.

1.1 General Context of Research

1.1.1 Role of information technology in health care

Information systems and information technologies are prevalent in almost every sector of U.S. society, including health care. The health care industry foresees information technology, particularly the Internet, as playing a pivotal role in the future delivery of traditional medical care. E-health and the field of medical informatics which deal with the storage, retrieval, sharing and optimal use of biomedical information for problem solving and decision making are heavily dependent upon the Internet as a strategic health care tool (Fagan, 2000). Traditionally, the use of computers in medicine has been classified as:

- Administrative,
- Clinical, or
- Special purpose applications

Administrative applications consist of the uses that are not limited to medicine, but can be found in any organization. However, specialized software packages such as *Medisoft* may be used in the computerized medical office, to help facilitate such administrative tasks as patient scheduling, maintaining database records, billing and accounting and communication with other computers via telecommunication lines and networks. The clinical applications directly support patient care. These consist of computerized patient monitors, computer-assisted surgery, the development of electronic prosthetics and other medical devices. Any applications of computer or information technology to health care that does not fit into the administrative or clinical category are

classified as special purpose systems (Burke et al, 2000, p. 67). Special purpose systems include computer-assisted instructions, research databases, expert systems, software that helps in the design and administration of medications, and interactive self-help software. Imaging tools such as MRIs, CT scans and PET scans have been considered special purpose applications.

1.1.2 Potential benefits of information technology in health care

In 1999, the Institute of Medicine (IOM) published a report, “To Err is Human: Building a Safer Health System,” which illustrated that medical errors kill between 44,000 and 98,000 people in American hospitals each year. According to the (1999) National Vital Statistics Report, more people die in a given year from medical errors than from motor vehicle accidents (43,548), breast cancer (42,297) or AIDS (16,516). To err is human, but errors can be prevented. For example, the use of medication order entry systems using data on patient diagnoses, current medications, and history of drug interactions or allergies can reduce prescribing errors (Bates, Leape & Cullen, 1998; Leapfrog Group, 2000). In 2000, the IOM followed with a report “Crossing the Quality Chasm: A New Health System for the 21st Century” that observed the disconnect between the advancement of technology and the health care system’s in ability to provide consistent high quality care to America. More specifically the report noted the absence of real progress in applying advances in information technology to improve administrative and clinical processes.

The IOM Quality of Health Care in America Committee developed strategies and recommendations to improve the quality of care. The committee emphasized that health care should be supported by systems that are carefully designed to produce care that is safe, effective, patient-centered, timely, efficient, and equitable. IT plays a critical role in the design of such systems as well as has incredible potential to improve the quality of health care. The National Research Council (2000) identified six major health-related domains in which Internet-based applications show great potential and benefits in delivery of health care services. These are:

- *“Consumer health. Consumers are using the Internet to search for health information, to obtain information on health plans or providers. The Internet can be used to post customized health education messages according to a person’s profile and health needs (Kendall & Levine, 1997).*
- *Clinical care. The Internet has the potential to make health care delivery more timely and responsive to consumer preferences . . .*
- *Administrative and Financial Transactions. In 1999, almost 65 percent of the 4.6 billion medical claims process by private and public health insurance plans was transmitted electronically (Goldsmith, 2000).*
- *Public health. IT can be used to improve quality of health care at the population level, with such applications as incident reporting, videoconferencing among public health officials in emergency situations, disease surveillance and delivery of alerts and other information to clinicians and health workers.*
- *Professional education. The Internet can be a powerful tool for undergraduate, graduate and continuing medical education for all types of health professionals.*
- *Research. The Internet opens many options for improving researchers’ access to databases and literature, enhancing collegial interactions, and shortening the time required to conduct and disseminate results to the field.”*

Despite the reported benefits of the application of IT in health care, systems cannot be effective unless they are used (Mathieson, 1991). It has been an IT phenomenon that people do not adopt and use systems that could potentially increase their productivity.

1.2 Problem Statement

This research aims at understanding physicians' intention to adopt IT. A major concern in health care is how to recognize, assess and manage the technical and non-technical issues to the adoption of IHA among physicians. Despite the reported advantages of IT investments and use in health care, many physicians, regardless of discipline or region still do not widely use Internet-based health applications in their clinical practices. The majority of clinical information is still stored in paper form and only a fraction of clinicians offer email as a communication option to patients (Hoffman, 1997). This dissertation, although not problem driven, focuses on an urgent need to understand physicians' intentions to adopt Internet-based health applications. Failure to do so will significantly slow the eventual acceptance of IHA to the detriment of health care nation wide and specifically in Hawaii (W. G. Chismar, personal communication, May 15, 2000).

Prior research suggests that a cause of this problem is that physicians often misunderstand the functions and full potential of the Internet (Wang & Song, 1997). Many physicians question the need to utilize information technologies in their daily routine of care giving. Fagan (2000) contends that health care professionals need to first, understand the proper use of knowledge and data, as well as the capabilities and limitations of information technologies; and suggest that medical informatics is an inevitable element in

the practice of health care of the future. In 2000, the National Research Council conducted a study, "Networking Health: Prescriptions for the Internet," which established a need for federal and private investment in the Internet to improve Americans' health. The findings assert that the Internet has great potential to improve health care by enhancing communications and improving access to information for care providers, patients, health plan administrators, public health officials, biomedical researchers, and other health professionals. However, the report concluded that one obstacle to the greater use of the Internet in health care is that health workers at all levels (physicians, care providers, administrators, and information system staff) do not fully appreciate the ways in which the Internet can improve the provision and administration of health care. Our research aims to provide a possible solution to the phenomenon of physicians' lack of adopting IHA, by better understanding the variables, which help to influence their intentions toward adoption.

1.3 Research Objective and Questions

The objective of this research is to help build a better understanding of IT acceptance in the health care sector. The focus of this dissertation is on physicians' intention to adopt Internet-based health applications. Three primary goals for this study are presented here:

- First, to provide empirical evidence about physicians' intention toward adopting Internet-based health applications,
- Second, to test a the extended technology acceptance model (Venkatesh & Davis, 2000) in the health care environment and

- Third, to build awareness in Hawaii's medical community about the potential uses of Internet-based health applications.

The aim is a theoretical exploration for the discussion of physicians' intention to adopt and the effectiveness of an IT model to predict such intentions. The research questions are based on technology acceptance literature as well as IT and health care research. Using Hawaii based pediatricians as a test bed, this investigation attempts to answer the following research questions:

1. What is the current use of the Internet by physicians in Hawaii?
2. Can educational interventions affect physicians' intentions to adopt Internet-based health applications?
3. How applicable is the extended technology acceptance model to physicians' intention to adopt Internet-based health applications?

1.4 Guide to the Dissertation

In chapter 2 the definition information technology and explanations as well as examples of Internet-based health applications are presented. Because this dissertation is grounded in the technology acceptance theory section 2.2 of the literature review presents the history of the technology acceptance model (Davis, 1989). Section 2.3 presents relevant technology acceptance research and section 2.4 gives an overview of the extended

technology acceptance model (TAM2) (Venkatesh & Davis, 2000) as well as justification for its use in this investigation.

In chapter 3, we reiterate the research questions and introduce the propositions, which were adapted from the research of the extended technology acceptance model. Key determinants of intention are, perceived usefulness and perceived ease of use. A modified TAM2 is presented in section 3.4, illustrating the propositions to be tested for this study.

Chapter 4 focuses on the methodology employed to investigate the research questions and test the propositions. We discuss the research design chosen for this dissertation as well as the selection of subjects, construct adaptation and operationalization, the administration of the educational intervention and methods of data collection. Overall, the procedures used for the testing of TAM2 constructs are presented in this chapter.

In chapter 5, the responses to the survey and non-response bias are reported along with descriptive statistics on the demographics of computer usage and IHA knowledge survey items. Statistical results of the test-retest method and the regression analyses of TAM2 are reported in sections 5.5 through 5.9 respectively.

Chapter 6 restates the research problem, questions and propositions. In chapter 6, we discuss the theoretical implications of the findings, the shortcomings the research and possible explanations for inconsistencies with previous TAM2 studies.

The last chapter of this dissertation summarizes the research objectives and findings. We suggest improvements to our research design and make recommendations for

future IT research endeavors that could facilitate a richer understanding physicians' adoption behavior.

CHAPTER 2

LITERATURE REVIEW

"There is a single light of science, and to brighten it anywhere is to brighten it everywhere."

-Isaac Asimov

2.1 Definitions of IT and IHA

2.1.1 General Definitions

The definitions of information technology and Internet-based health applications are important here because they establish the foundation for this research. The most general definition for information is that information is data (a fact, a number, a word, a image, or a sound) that is meaningful to someone. For example, "The patient should take (2) Zirthromax® (250mg) tablets by mouth twice daily" is data and meaningful information to a physician, pharmacist and patient. The combined words of information and technology have become nomenclature in the field of information systems. Information Technology or (IT) is defined as the science and activity of storing and sending out meaningful data by using computers and other equipment within an information system (IS), which is a collection of components that work together to provide information to help in the operations and management of an organization (2001, p. 4.).

Information systems and information technologies are prevalent in every sector of our society, including healthcare. The healthcare industry envisions information technologies, particularly the Internet and the World Wide Web (WWW) as playing a

pivotal role in the future delivery of healthcare. The use of the Internet, which is an interconnected system of international networks that connects computers around the world via the TCP/IP protocol, in healthcare management has increased tremendously in recent years. The WWW, usually called the Web is a service on the Internet that provides easy access to many types of information, including healthcare or medical related information. The Web is a hypertext system, which means that information on the Web is linked so that users can easily go from one piece of information to another, related page by using a browser. Web information includes text, graphic images, pictures, video and sound. The Internet includes a number of other services besides the Web, which are as equally important to the functionality of Internet-based health applications, including

- *Telnet*. This service connects one computer on the Internet to another computer on the Internet so that a user at the first computer can use the other computer as if he or she were directly connected to it (i.e., a physicians can telnet from his home computer to his office computer and update patients' records from his home office).
- *FTP* (File Transfer Protocol). This service is used to transfer a file from one computer to another and is used for uploading and downloading files (i.e., patient records or radiology reports).
- *Gopher*. This menu-driven service provides easy access to information on the Internet.

- *Usenet or NetNews.* This service allows users to share information about a wide range of topics (i.e., thousands of virtual bulletin boards on different subjects, including health related information).
- *Chat.* This service allows users to carry on conversations by keying comments and receiving responses from other users, all within a few seconds (i.e., a Hawaii-based physician may talk with a colleague easily and inexpensively in another state or country).

Internet-based health applications or (IHA) are described in section 2.1.2. These applications consist of, but are not limited to electronic medical records, electronic billing, patient scheduling, patient monitoring, remote consultation, and email.

2.1.2 Internet-based health applications

For the purpose of this research, we define Internet-based health applications (IHA) as any Internet-accessible application that enables physicians and patients to actively participate in the current e-health environment. IHAs are further described here as the use of a computer or personal digital assistant (PDA) to prepare, review annotate, maintain or transmit health related information via the Internet. For example, using computers and application software for patient scheduling, charting, monitoring, billing, the tracking of names and addresses and email are computer applications. A healthcare information system may involve a single application or it may include several applications. Often the term *application* is used when referring to a small, uncomplicated system and *information system* is used for a large, comprehensive system. In addition to computers, information systems also include other types of technologies.

Communication links, such as telephone lines, satellites, fax machines, video cameras and audio speakers are found in an information system (Nickerson, 1998). Taken together, the computers, other technology, application software and the Internet included in the information system and used for the purpose healthcare determine Internet-based health applications.

We contend that IHA can enable the healthcare industry to reduce inefficiencies and medical errors in the care delivery process (HIMSS/IBM Leadership Survey, 2000). Coile (1999) cites a few the benefits of an Internet-enabled medical practice:

- Telemedicine is “the use of computers, the Internet, and other communications technologies to provide medical care to patients at a distance” (NLM National Telemedicine Initiative 1996). The medical information transmitted can be in any form including voice, data, still images and motion video. Telemedicine has been most effective in rural states, where care is often impeded by the relative lack of physicians, particularly specialists, and the distance patients must travel to see them. With telemedicine established between small local hospitals, and academic medical centers, physicians and patients can avoid difficult days on the road or the expense of air travel. Telemedicine encompasses many subspecialties including:
 - Teleradiology: sending radiological images in digital form over telecommunication lines
 - Interactive videoconferencing or teleconferencing: allows doctors and patients to consult in real time, at a distance
 - Telepathology: transmits microscopic images over telecommunications lines
 - Telepsychiatry: the delivery of therapy using teleconferencing;

- Electronic medical records available on a 24-hour basis; documentation of medical treatment is going online. Although privacy and security present problems for computerized records, electronic medical records solve problems because paper records may be illegible and can only be read by one person at a time. Electronic records are stored on a computer and can be displayed on any terminal on a network with access to the records (Burke et al, 2000);
- Remote patient monitoring; allows patients to be monitored at home, an example is a telespirometry system that is used at home for asthmatic patients;
- Online medical literature searches for academic research and patient diagnosis. One of the best know online medical databases is MEDLINE, which contains books and over six million articles from 3500 medical journals;
- Physician communication with patients via email;
- Collegial consultations without geographical boundaries, and
- Internet-enabled consumer eligibility, claims processing and electronic payment.

According to an Institute of Medicine report, (1999) IT could improve healthcare in the six key areas, which include safety, effectiveness, patient-centered, timeliness, efficiency and equity. In the area of safety, evidence shows that automated order entry systems can reduce errors in drug prescribing and dosing (Bates et al, 1999).

The Internet is fast becoming the universal communication media by which medicine would have no boundaries. IT has enormous potential to improve the quality of healthcare, however one of the most challenging, and least understood, barriers to the

application of useful IT in healthcare relates to human factors (National Academy Press, 2000, p. 175). The proceeding section summarizes a variety of pertinent prior IT and IHA studies in healthcare. The following research highlights the potential benefits and plausible reasons for the past failures of information technology in providing quality healthcare.

2.1.3 IT adoption in healthcare

Healthcare delivery is being transformed by advances in e-health and by the empowered, computer-literate public. According to Ball and Lillis (2001) consumers are ready to become partners in their own health and take advantage of online processes, health portals, physician web pages and e-mail, this new breed of consumer is slowly redefining the physician/patient relationship. Positive outcomes are improved clinical decision-making, increased efficiency, and strengthened communication between physician and patient. However, physicians and healthcare organizations should become fully aware of their new roles in the e-healthcare arena.

The new e-health consumers require convenience, control, and choice. Today the Internet facilitates *Consumer Education, Disease Management, Clinical Decision Support, Physician/Consumer Communication and Administrative Effectiveness*. Ball and Lillis recommend that physicians get ready for this new environment by playing a proactive part. Change is inevitable and physicians can help to make these changes happen. The authors suggest that physicians recommend appropriate web sites to their patients, create web sites of their own, and exchange email with patients and colleagues.

They also recommend that healthcare organizations focus on e-service and interactivity, offer appropriate training for physicians and support staff, and most importantly ensure that the technology matches business goals.

In our exhaustive search of literature for studies related to information technology and healthcare, we uncovered a variety of articles that investigated the phenomenon of IT adoption, IT use and IT failure in the healthcare environment. The following section identifies articles relevant to our research.

Cimino, Patel and Kushniruk (2001) sought to study the phenomenon of patients having access to their own medical records in order to determine what impact this access would have on their relationship with their health care providers. The authors created the Patient Clinical Information System (*PatCIS*) to interface with the clinical data repository at New York Presbyterian Hospital to allow patients to add to and review their medical data. They also provided educational resources and automated advice programs. Thirteen subjects were given access to the system over a nineteen-month period. Their activities were reviewed in the system's usage log. Data were collected via questionnaire and telephone interviews. The authors found that patients varied in their use of the system, from once per month or less, to one or more times per day. All of the patients primarily used the system to review laboratory results. Both the patients and their physicians believed that use of the system enhanced the patients' understanding of their conditions and improved their communication with their physicians. There were no adverse events encountered during the study. Along similar lines of investigation, Elberg (2001) believes that the approach of today's electronic patient records (EPR) seems so

narrowly focused on automation of the existing paper-based records by means of information technology that it becomes obvious to raise the question: 'Will these automation efforts become an impediment to innovation in products and services in health care?' He discusses how objectives like improvements and innovations in products and services in health care are met by means of information technology (IT), and he argues that a shift of focus from technological innovation to innovation in products and services is necessary in order to obtain maximum benefit from IT in healthcare.

Many researchers and practitioners believe that Internet-based, personal health records have the potential to profoundly influence the delivery of health care in the 21st Century. This can be accomplished by changing the loci and ownership of the personal health record from one that is distributed among the various health care providers a patient has seen in his lifetime, to one with a single source that is accessible from anywhere in the world and under the shared ownership and control of the patient and his provider(s). Internet-based personal health records (PHRs) include any internet-accessible application that enables a patient (or their guardian) to review, annotate, create or maintain a record of any aspect(s) of his health condition, medication, medical problems, allergies, vaccination history, visit history or communications with his healthcare providers. Sittig (2002) contends that the current state-of-the-art systems for personal health records are best characterized as 'beta releases'. He surmises that as the field matures and gains more experience, these applications will improve significantly in ease of use and functionality.

Lee (2000) examined the adoption of medical records as a technology by measuring and comparing the attitudes of groups of ambulatory care staff and physicians toward adopting an electronic medical record (EMR) system developed by Physician Microsystems, Inc (PMSI), using the Perceived Characteristics of Innovating (PCI) scales developed by Moore and Benbasat (1991). The subjects were selected from the Medical University of South Carolina Medical Centers (MUSC). The 43-item PCI scale scores were compared by professional group and by clinic location. The professional groups were re-categorized into physician and non-physician groups. The overall findings of this study were that potential users of the ambulatory care EMR system at MUSC had generally positive or neutral attitudes toward the system. There were a number of significant differences noted among the professional groups, particularly between the physician and non-physician groups. The physician groups had less positive perceptions than the other groups. Administrative personnel perceived that PMSI would be easy to use versus the physician groups' perception that it will not be easy to use. The findings of this study support the notion that physicians may be less inclined to adopt the EMR than other professional groups. This appears to be the case at least at MUSC, regardless of clinic location. Lee recommends altering the existing training sessions and support structure in an effort to improve physicians' scores in *Compatibility*, *Relative Advantage*, *Image*, and *Ease of Use*. The author also suggests using opinion leaders to demonstrate how the system is used effectively in practice. This demonstration could help to improve the physicians' perceptions of using the EMR at least along the demonstrated dimensions.

Computers as well as the Internet have diverse uses in health promotion, healthcare, and disease management.

The following study was incorporated into the literature for several reasons: 1) it is a recent study involving an IT innovation and healthcare, 2) it evaluates the impact of a computer-based educational application which teaches asthma self-management skills to urban, minority children and 3) the pretest posttest trial design and pencil-and-paper questionnaire methodology proved insightful for our research purposes.

Shegog, Barthomew, Parcel, et al. (2001) examined the effect of an educational CD-ROM for pediatric asthma self-management education, *Watch, Discover, Think and Act* (WDTA). Seventy-one minority children from large urban asthma clinics, community clinics, and schools were randomly selected for their study. The authors administered a pretest - posttest intervention trial to assess the motivational appeal of a computer assisted instructional program and evaluate the impact of the program in eliciting change in knowledge, self-efficacy, and attributions of children with asthma. The results indicate that knowledge scores increased significantly for both groups, but no between group differences were found; children using the program scored significantly higher ($P < 0.01$) on questions about steps of self-regulation, prevention strategies, and treatment strategies. These children also demonstrated greater self-efficacy ($P < 0.05$) and more efficacies building attribution classification of asthma self-management behaviors ($P < 0.05$) than those children who did not use the CD-ROM program did. The overall conclusion posits that the computer assisted educational program is an *intrinsically motivating educational program that has the ability to effect determinants of*

asthma self-management behavior in 9- to 13-year-old children with asthma. This, coupled with its reported effectiveness in enhancing patient outcomes in clinical settings, indicates that this program has application in pediatric asthma education. The authors' future goal is to conduct a diffusion study to determine the best way to achieve *dissemination, adoption, implementation, and maintenance in clinics*.

The development of new methods for assessing the effectiveness and usability of healthcare application systems like the above mentioned WDTA system along with World Wide Web health applications is becoming a critical issue according to Kushniruk, C. Patel, V. L. Patel and Cimino (2001). A number of studies have investigated the use of Internet-based information systems by healthcare providers and described development of evaluation instruments (typically questionnaires) for assessing their use of information technology. However, the authors believe that an in-depth understanding of the effects of the use of the WWW, in providing patients and providers with access to their medical data necessitates new approaches to evaluation. Kushniruk et al. (2001) describe the distance evaluation (i.e. *Televaluation*) of emerging Web-based information technologies, which involves evaluation from a distance. In health informatics evaluation, there is a need for application of new ideas and methods from an interdisciplinary approach. Cognitive science provides the theoretical frameworks for this research. Cognitive science is a diverse endeavor that builds on several areas of research, including cognitive psychology, computer science, linguistics, anthropology, and artificial intelligence. The authors present a framework for conducting evaluations of health-care information technologies that integrates a multiple methods, ranging from

telephone interviews, deployment of on-line questionnaires to remote video-based usability testing of user interactions with systems. Surveys were mailed to 200 physicians, 11 physicians returned permission forms by patients; eight patients participated in the study. The authors conclude that an approach to evaluation in medical informatics that takes into account both technological advances in systems that we are evaluated, as well as methods and theoretical frameworks from areas such as cognitive science, promises to provide researchers with detailed information on system usage. This type of information will be invaluable in the iterative process of design, evaluation and re-design that complex healthcare systems will require (Kushniruk et al. 2001).

As the Internet becomes a main source of health information to consumers, it also is transforming the practice of medicine, particularly re-inventing the doctor-patient relationship (Coile, 2000). Communication between patient and providers has always formed the backbone of the patient-provider relationship. Communication between patients and their providers have often been difficult. Before the advent and subsequent incorporation of the telephone into their medical practice, the burden of communication was the primary responsibility of the patient, who was forced to visit his/her doctor in order to have a conversation (Sittig, King & Hazlehurst, 2001). Incorporating the telephone into the medical practice also forced the physician to handle calls both day and night. Today, email has the potential to change patients' and physicians' lives forever. The prospect of patients' ability to send email messages directly to physicians forces them to establish new expectations and procedures surrounding this new mode of communication. Sittig et al. (2001) conducted a study to determine how a group of

internet-active, e-mail-ready patients currently use, or potentially view the ability to exchange e-mail messages with their health care provider. The subjects were selected from registered users of WebMD. The researchers administered the 9500 surveys through e-mail. Although 1500 responded, final analysis was conducted using the 954 respondents, giving the authors a 10% response rate. Of the 954 only 60 respondents (6%) reported actually sending an email to their physician. A follow-up survey was sent to those 60 respondents. When asked to identify the main issues that prevented them from sending messages to their providers, responses of the 954 initial respondents indicated that, 69% did not have their provider's email address while 21% were concerned that someone else other than their healthcare provider would read their message. In addition, over 64% reported that they did not know if their provider used email.

Of the 60 respondents who actually reported sending email to their provider, 64% said their provider gave them their email address while 17% reported that they obtained the email address off the provider's website. Seventy-five percent of the 60 respondents reported that they were either somewhat or completely satisfied with their communication exchange via email with their provider.

Sittig et al. conclude that it is important for physicians to establish email guideline (Kane, and Sands, 1998), respond to all consumer generated emails, respond within 2 days, answering the question posed, having an auto-reply mechanism in place to confirm receiving the email. Email messages increase physicians' workflow, but saves time and

costs to patients overall. The primary question remains, “Are physicians ready to begin receiving patient questions via email?”

Continuing with the theme of meeting patients’ needs, van't Riet, Berg, Hiddema and Sol (2001) conducted a pilot evaluation of an electronic patient information system for children with amblyopia and their parents. In amblyopia, normal vision in one eye fails to develop because of a difference in vision between the two eyes in early life. The aim of the investigation was to determine if the information system would be able to improve the quality of care, as indicated by an improvement in the effectiveness and efficiency of care, and in an increase in patient satisfaction. *Qualitative research methods* were used to explore the impact of the information system on children and their parents, with the intention of finding suitable indicators for a potential further, quantitative study.

Subject selection included 14 families that were currently undergoing treatment for amblyopia at the Rotterdam Eye Hospital in the Netherlands. The age of the children ranged between 2 and 9 years old. The age of the parents ranged between 29 and 60 years old; their mean age was 35 years. Most of the parents were highly educated; in nine out of the 14 families, at least one of the parents held a college degree.

The Dutch Digital Hospital designed the patient information system, which consisted of a CD-ROM and an Internet site. The Internet site, specifically developed for this project consisted of four parts: a Chat box, a Question and Answers section, a Newsletter and Games. The Chat box offered virtual contact with fellow sufferers, supervised by an orthoptist or ophthalmologist. During the pilot evaluation phase, the Chat box was open for use one night a week for one hour.

van't Riet et al. (2001) conducted in-depth interviews and made physical as well as virtual observations of the system use. The actual use of the system by patients was very disappointing. The system was utilized at a minimum and had marginal effects on the quality of care for children with amblyopia and their parents. No chatting between patients ever evolved, thus a support network did not emerge. It appeared that the main problem underlying this patient information system was that the needs of those people who would actually use the system had never really been investigated. The designers had built their assumptions about these needs into the system. These appeared to be mistaken at so many levels that the system could not become a success. Because of the pilot study, *the patient information project was thoroughly transformed*. The researchers contend that the disappointing conclusions are mainly due to the lack of fit between the content and functionality of the system and the needs and capacities of the target group. Most important here is the observation that amblyopia does not generate a large need for information in the first place. Most of the parents felt that the elaborate patient information system for amblyopia over shot its aim. An important caveat to note here is that the parents who joined the study were highly educated. Perhaps the system would have been more effective if there had been a larger portion of less educated people using the system. The researchers might assume that less educated people would be more in need to 'be informed', less compliant, and/or less able to cope than well-educated people. If these assumptions were true, having mainly educated well-educated people in your sample reduces the potential of the system to be 'effective' (van't Riet et al., 2001, p. 11).

This study makes clear that a thorough exploration of user needs before building a system, using qualitative research methods, may be crucial because it can prevent mismatched assumptions and maximizes the chance that the eventual information system meets its most important aim: to enhance patient empowerment and improve the quality of care.

In reference to designing effective systems, Zimitat (2001) discusses the unique opportunities that the Internet, new information and communication technologies available through the Internet, provides to medical educators when developing learning environments with real potential to improve physicians' knowledge and effect change in their clinical practices via on-line CME courses.

In 2001, Zimitat found that more than 100 websites offered on-line CME courses in USA. However, few of the courses appeared to be based on sound educational principles or CME research. The majority of the current courses closely resembles their traditional counterparts and appears to be mere substitutions for old-technology CME resources. The author found that frequently paper-based text and graphic materials are simply converted into a screen-based text and graphics format (e.g. the electronic textbook, lecture notes on the web, multiple choice questions and downloadable pdf files). While some CME providers add unique features of the Internet to enrich their websites (e.g. audio-slide show and quick quizzes) they do not employ strategies to optimize the learning opportunities afforded by this new technology. (Collis, 1997) suggests that if we are serious about developing effective on-line CME courses, then some 'pedagogical re-engineering' is required to re-conceptualize and redesign CME for

technology-rich and on-line environments in light of experience and evidence (Harden et al., 1999). The adoption of adult learning principles, reflective practices and problem-based approaches can be used as a foundation for sound CME design. The author argues for an evidence-based and strategic approach to the development of on-line CME courses designed to enhance physician learning and facilitate change in clinical behavior. Successful on-line CME requires an appropriate framework for design, adaptation of traditional learning activities into an on-line context, selection of appropriate technologies and multiple strategies for encouraging participation afforded by those technologies. Zimitat contends that more research into learning on-line and how best to re-engineer successful *medical* educational approaches to the on-line context are essential to the success on-line CME in achieving the goals of enhancing physician learning, facilitating change in clinical behavior and ultimately providing high quality healthcare.

The following literary entry focuses on two the themes that emerge and recur in the recent educational literature on the subject of web-based learning and teaching; these are how socio-economic factors and gender might influence the use of information technology (IT) by students. We include this article for several reasons, 1) because many individuals from underrepresented and disenfranchised communities and countries have become physicians and nurses, 2) a substantial number of American physicians and nurses are female and 3) on-line CME courses are ever increasing. These factors generate relativity to our study.

Researchers often enthuse about how web-based learning will somehow reduce inequalities in student's access to education. However, in this paper it is argued that most

of the evidences in the literature of the potential of web-based learning has taken too little into account of the potential problems and limitations of the medium. It is argued that web-based learning underscores and may in fact increase inequalities rather than eliminate them. Washer's (2001) aim for this article was twofold. First, he examined the development of web-based learning and the potential ways it can be useful for nursing students. Second, he focused on those variables that could influence or inhibit student usage of web-based learning materials, in particular, the influence of socio-economic factors and gender. He argues however that the adoption of the computers and the Internet has inherent difficulties, which are often overlooked or even played down.

The nursing profession, like all professions, will have to come to terms with the necessity of information literacy in its overall development as a profession. Nursing graduates will need to have the skills to use the IT so as to enable them to adapt to the technical and technological changes and to implement the 'evidence-based nursing' of the future. Washer contends that recent studies on the potential of the Internet for supporting student learning, the advantages of the medium are often recounted uncritically. Proponents of web-based learning argue that it will somehow reduce the inequalities from which those non-traditional students have suffered in education. In terms of socio-economic background and gender, using web-based learning is often thought to be a 'democratizing' or *equalizing* force in education. Advantages of web-based learning in nursing can be seen in courses like the Northwest Technical College's [2000] *Distance Practical Nursing*. This type of course includes some face-to-face teaching with an open learning approach in which the Internet is used to distribute course

material and e-mail or video conferencing is used for the students to communicate with each other and with lecturers remotely. Some courses are based entirely on the Internet and have little or no face-to-face contact. Such courses often use the communication potential to set group work tasks and have group discussions asynchronously between students (where students may even be in other countries and time zones). Washer suggests that students undertaking this type of course may need a higher level of motivation. On-line CME courses for physicians are ideal in this type of medium. (Gilliver et al. 1998; Pickering, 1995; Ribbons, 1998; & Whalley, 1995) argue that the Internet provides an opportunity to radically improve the direction of higher education. They argue that it will widen access to education, that teaching will be decentralized and more effective learning will take place, that the Internet provides flexibility and better communication. In short, the authors contend that in many different ways that education will be somehow democratized by the adoption of the Internet.

Washer (2001) believes that while acknowledging these advantages, there are inherent disadvantages to using web-based learning. The literature seems to show that the women may be at a disadvantage to men in using computer technology in general and Internet in particular. Other research that has focused on gender differences in on-line learning environments (Barrett & Lally, 1999; Yates, 1997) suggests that men are more assertive in their use of e-mail for example, while women students are self-censoring in their e-mail responses to discussion groups. These authors suggest that gender differences in everyday interactions are reflected in on-line interactions. In the context of nurse education, women account for vast majority of student nurses. Although the

evidence is not conclusive, Bauer (1995) suggest that women may be more likely to resist the introduction of new computer innovations in general. (Washer, 2001, p. 459) contends that this has obvious implications for the introduction of web-based learning into nurse education, as the success of web-based learning is contingent on how nursing students respond to technology in the wider context. The reasons are not related to physical access, rather to more general cultural issues. Another issue relates to socio-economic factors such as home computer ownership and the potential for further disadvantaging the most disadvantaged (the poorest) student nurses. The more non-traditional the student nurses are, the less able they are likely to be in terms of using the Internet, both because they lack the finances to pay for their own computers as well as unfamiliarity with basic IT skills.

Washer concludes that the Internet provides a *golden educational opportunity* for increasing informational literacy and lifelong skills. However, these advantages are the only possible with an investment in appropriate resources. The Internet will never satisfactorily enable cost savings without having an impact upon the quality of the nurse education currently provided.

This literature investigation has revealed that there are many barriers to the adoption and use of information technology in the healthcare industry. Age, gender, culture, perceived self-efficacy and individual differences are but a few. The following several studies highlight various barriers to the adoption of IT by physicians and healthcare organizations as a whole.

Sobol, Alverson, and Lei (1999) report that the increased emphasis on national health care plans, cost reduction, and additional record keeping has given impetus to the adoption of computerized information technologies in hospitals. Sobol, Alverson, and Lei (1999) conducted a series of in-depth case studies in large, multi-hospital health care systems in Dallas, Texas that revealed ten important barriers to the adoption of information technologies, which are classified into four strategic categories:

- Knowledge problems,
- Approval problems,
- Design problems, and
- Implementation problems.

These aspects were uncovered by using focus-group studies and individual interviews with chief information officers, physicians, consultants, and medical technicians, administrative staff and by consulting numerous journals in the field. The 10 most important barriers:

1. Lack of knowledge of available technology,
2. Fear of the unknown
3. Uncertainties relating to potential cost and Return on Investment
4. Approval problems
5. Database difficulties
6. Facility design

7. Equipment compatibility with existing systems
8. Training problems
9. Regulatory Issues
10. Legal Issues

These were chosen because they were listed by three of the following sources: physicians, hospital employees, and academic literature of different hospital information societies, such as the College of Healthcare Information Management Executive (CHIME) and the American Health Information Management Association (AHIMA). Sobol et al. (1999) believe that these sources represent the salient indicators of technology use because they are directly affected by the introduction of new practices into their daily operations.

Sobol et al. contend that health care organizations tend to move slowly in their adoption of information technologies. In large part, this may be due to the many stakeholders involved in a hospital. The differing needs of physicians versus administrators make it difficult to have one champion for all IT needs. The researchers believe that the diffusion of power makes adoptions more difficult than in centralized organizations. They propose that with so many individual requests, it is difficult to focus on organizational needs. Moreover, it is important to note that physicians are not employees of the hospitals. Physicians work *in* the hospitals. There are not the same *cultural* relationships that there are in most workplaces. Consensus is constantly a

problem, and physicians would rather have new diagnostic innovations than IT innovations.

Sobol et al. believe that a number of political, social and cultural events may lower many of the barriers in years to come. First, younger physicians will be exposed to improvements in computers and IT in high school, college, and medical school. This should lead to increased absorptive capacity and the desire to adopt new information technologies. In the future, systems will become user-friendlier, and this will encourage even the older physicians to use them.

Second, as new health plans are based on capitation (a fixed sum of money per member per month or per day), the economic incentives of physicians and hospitals will fall into alignment. The authors believe that the need to reduce cost per patient will become more important in the future than it is now. Reducing fixed cost and duplication of low-value activities becomes a critical strategic imperative. In addition, the adoption of the computerized patient record (CPR) and the availability of more hardware through organizational adoptions will encourage more individual physician adoption.

Sobol et al conclude by recommending that future research in this area of barriers to the adoption of IT technology in hospitals should first prioritize the importance of these barriers by surveying CIOs, physicians, and other stakeholders. Methods to increase adoption should also be solicited. Moreover, methods of simplifying and adapting computer uses so that they really handle the physicians' and nurses' needs and work styles must be solicited and implemented.

Johnson (2001) reviewed literature to better understand the barriers that impede the adoption of pediatric information technology. Information technology (IT) is a critical but underused component of health care. Many factors contribute to the inconsistent adoption of IT. In an effort to reveal these factors, Johnson looked at manuscripts using a MEDLINE search combining the terms medicine, information systems, and technology transfer. He also obtained references cited by relevant articles. Finally, Johnson explored the Internet using <http://www.google.com> and <http://www.northernlight.com>. Articles discussing barriers or factors affecting the adoption of IT were considered for inclusion, while articles unrelated to clinical IT were excluded.

Johnson found that a variety of barriers exist that affect the adoption of useful technologies. Situational barriers include challenges imposed by the current national health environment, financial and legal risks associated with technology purchasing and use, and access to technology. The most significant barrier is that pediatric health care practitioners (PHCPs) may lack the knowledge or training to use IT effectively. Barriers are adapted and grouped into four categories for Johnson's study. Those barriers to IT were as follow – *Situational* (time and financial pressures, unproven ROI, insufficient access to internet and IT, software unaffordable for small offices), *Cognitive and/or Physical* (insufficient computer skills and physical disabilities), *Legal* (confidentiality concerns), and *Attitudinal* (insufficient research about IT in pediatrics, insufficient knowledge about IT, apprehension about change and philosophical opposition to IT). To overcome barriers the author recommends barrier specific approaches:

1. *Situational Barriers* – conduct demonstration projects, disseminate information about possible ways for obtaining financing, collaborate with vendors, work with pediatric healthcare providers.
2. *Cognitive barriers* – hands-on seminars, conduct research, develop IT adoption models
3. *Legal* – establish policies and regulations.
4. *Attitudinal barriers* – increase publication about IT initiatives, convene seminars and workshops, collaborate with fed agencies, increase exposure to IT vendors, experts and researchers, and conduct research-evaluating effects of IT.

Johnson concludes that although some barriers exist that may be challenging to overcome, other barriers, such as the lack of knowledge about the uses of IT, are imminently solvable. Efforts to overcome these barriers should begin in earnest and should include educating stakeholders in the care of children and adolescents, as well as improving the knowledge about various technologies available to support pediatric and adolescent health care.

Herbert (1994) investigated nurses' attitudes toward the adoption of information technology. Herbert's research investigated the application of theories proposed by social psychologist (Ajzen, 1975; Fishbein & Ajzen, 1975; Moore & Benbasat, 1990 and Rogers, 1983) to understand the adoption of new technologies in health care settings, particularly focusing on the relationship between attitudes and expectations concerning the technology and the intent to adopt it.

Herbert conducted a field study focused on individual beliefs influencing nurse's adoption of bedside terminals as a point of care technology to reduce the cost of patient care by increasing efficiency of data collection and retrieval. The research model was adapted from the research of (Moore and Benbasat, 1990; 1991). The field study was conducted using questionnaires and interviews. Data were collected from a convenience sample of nurses employed at the Red Deer Regional Hospital Center. Four hundred and seventy-nine questionnaires were distributed with 151 usable returns for a response rate of 32 percent.

Herbert reported that the research model based on the theories of diffusion of innovations and reasoned action was supported. Three factors (compatibility, relative advantage, and result demonstrability) and on subjective norm factor (director of nursing) were the strongest predictors of behavioral intention to use the point of care technology. The results showed that certain beliefs related to attitude and subjective norms do play a more significant role in predicting behavioral intent. Unexpectedly, ease of use did not appear to be a significant factor that influenced the intent to use the technology. Based on the findings, Herbert believes that application of organizational theories related to adoption of innovation can be helpful in understanding similar phenomena in health care. Using behavioral models can be important tools to assist in explaining and interpreting behavior in using information technology through an understanding of factors and processes that influence it. Herbert posits that healthcare administrators can use this information to effect positive change in their organizations.

In hospitals and other Healthcare settings, increasingly, hands-on computer use is becoming an important behavior for effective job performance. The literature has identified differences that relate to computer use between occupational categories in health services.

In 1998, Jayasuriya conducted a study to identify factors that determine computer acceptance among occupational groups in Community Health and to predict the factors that relate to computer use. A survey was administered to 420 Community Health staff in one health service area. The questionnaire was developed, as a part of the training needs analysis for computer training. Computer skills were measured using an objective measure specific for each application. As an example, word-processing (WP) and database (DB) on a Likert scale of 1-5. There were 113 nurses and 40 health administrators among the 302 respondents who completed the survey.

Health administrators were found to have a significantly higher training in computers, a higher frequency of use and a higher level of skill for both applications (word processing (WP) and database (DB) than nurses do. The results of a stepwise regression analysis showed that about 55% of the variation in the use of WP was explained by computer skills, perceived usefulness (PU) and designation. In the case of DB use, PU was the only significant predictor explaining 53% of the variation. Both level of education and prior training were not significant predictors. (Jayasuriya, 1998) reported that the implication for health informatics education (and service training) of the research findings is that, in the workplace, health professionals would use computers when they perceive it to be useful for performance in their job.

The previous section highlighted pertinent research pertaining to information technology and healthcare. As discussed the Internet and other information technologies show great potential for reducing the cost of healthcare, as well as improving the safety of healthcare consumers, eventually enhancing the overall quality of healthcare delivery. However, e-health plans have failed because of a number of factors, including complexity of healthcare, failure to understand healthcare's privacy and security issues, failure to understand the cultural obstacles to change, failure to understand the historical perspectives of IT in healthcare and more importantly failure to understand physicians' and other healthcare personnel's adoption behavior.

The following sections of this chapter present the theoretical model chosen for this dissertation as well as in-depth discussions of prior research utilizing this model. We present these studies as the literature review because they provide a foundation for the current research.

2.2 Technology Acceptance Model

Why do individuals accept or reject technology? The importance and perpetuation of this research question has been a long-standing issue in Management Information Systems (MIS) studies. Researchers have investigated the phenomenon of user acceptance, adoption and use of technology. Empirical support has favored the likes of intention models such as the Theory of Reasoned Action (TRA), (Davis, Bagozzi & Warshaw, 1989; Hartwick & Barki, 1994; Ajzen & Fishbein, 1980; Ajzen, 1988), the Theory of Planned Behavior (TPB), (Mathieson, 1991; Taylor & Todd, 1995; Ajzen,

1988; 1991), the Model of PC Utilization (Thompson, Higgins & Howell, 1991), and the Technology Acceptance Model (Davis, 1989; Davis et al. 1989) have reportedly explained a substantial proportion of the variance in usage intentions and behavior.

Among the mentioned models, TAM is a robust model in explaining and predicting system-usage behavior. TAM has become a well-established model in the IS and MIS field. It is robust, powerful, and reliable. As of December 2001, the Institute for Scientific Information's Social Science Citation Index® listed over 400 journal citations to the first journal articles (Davis, 1989; Davis et al. 1989) which introduced TAM's perceived usefulness and perceived ease of use constructs.

The following section presents a detailed overview of the original technology acceptance model, beginning with a description of TRA, which serves as TAM's theoretical underpinning. The chapter continues with the scale development, validation and previous studies, which have applied TAM to various technologies and target audiences to help substantiate TAM's reliability. The final portion of this chapter will describe the extended technology acceptance model.

2.2.1 History of the technology acceptance model (TAM)

The goal here is to acquaint the reader with the history of TAM and subsequently TAM2. It is important to discuss TAM's formulation, scale development and validation process. It is essential illustrate TAM's significance and importance to this study, as well as to the fields of MIS, IS and medical informatics.

In 1989, Davis developed and validated new scales for two specific variables; *perceived usefulness* and *perceived ease of use*, which he operationalized as the

fundamental determinants of user acceptance. The theoretical underpinnings for TAM are from Fishbein and Ajzen's (1975, 1979) theory of reasoned action model (TRA). The TRA model contends that beliefs influence attitudes, which in turn lead to intentions, which then guide behaviors. Fishbein, (1963) submitted that attitudes are a function of the sum total beliefs about the attitude object. He contends that salient beliefs are the immediate determinants of a person's attitude. TRA postulate that attitudes flow reasonably and instinctively from beliefs, so intentions and actions follow reasonably from attitudes. Ajzen and Fishbein's theory assumes, that as-a-general-rule, we *intend* to behave in positive ways toward things, objects, and people that we like and in negative ways toward objects and people we dislike (Ajzen, 1988). Davis adapted TRA to operationalized *intention*, which postulates that people take into account all available information and consider the implications of their actions. TRA submits that a person's intention (determination to act in a certain way) to perform or not to perform a certain behavior is the immediate determinant of that action. The research integrates TAM's operationalization of intention with that of Howard and Sheth (1969) marketing Theory of Buyer Behavior. Their analysis of attitude is quite similar to that of TRA and TAM in the sense that attitude affects an individual's intention to purchase or use a product. The relation between attitude change and purchase was viewed as that of feedback, which over time is a two-way effect. Howard and Sheth argue that at any point in time attitude can cause a purchase or an *action*, but that purchase or *action*, by way of the satisfaction that comes from it, can cause attitude change (1969, p.62). It is a goal of this research to affect a positive attitude change of physicians toward Internet-based Health Applications.

The embedded assumptions of TRA (Ajzen & Fishbein, 1980), that all individuals act, think, or even believe in logical or rational ways has encouraged the modification of intention. Howard and Sheth (1969) define *intention*, as a verbal statement or combination of statements or indications by *physicians* in response to a question about the strength of their intention to use a unit of the product (IHA) during some specified period.

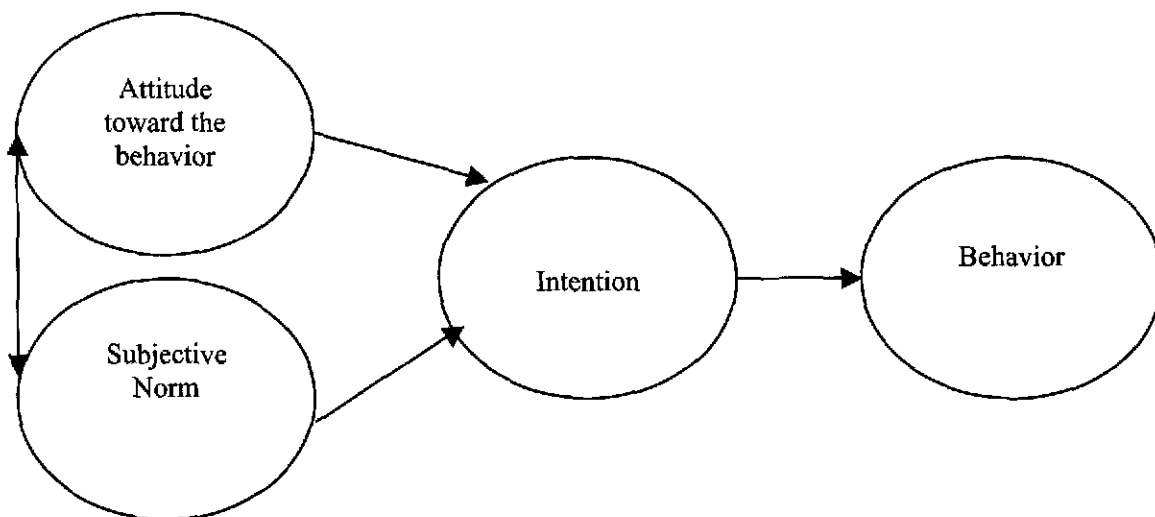


Figure 2.1. Theory of Reasoned Action
(Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980)

Let us consider how the configuration of beliefs may lead logically to the development of attitudes that are consistent with those beliefs. Fishbein (1963) states that we form beliefs about an object by associating it with certain attributes, for example, with other objects, characteristics, or events. Therefore, perhaps as a result of watching news programs, we may come to believe that genetic cloning (the object) is illegal, immoral and if permitted by government will lead to a greater socio-economic disparity

between the rich and poor (attributes). As shown in Figure 2.1, the TRA model implies that since the attributes that come to be linked to the object are already valued positively or negatively, we automatically and simultaneously acquire an attitude toward the object. The authors contend that the subjective value of each attribute contributes to the attitude *in direct proportion to the strength of the belief*. In other words, the stronger the attribute, the more salient the belief, hence the more influential the attitude toward the object in question becomes. Figure 2.2, presents an equation, structurally similar to that of Rosenberg's (1956), which describes the way in which beliefs combine to produce an attitude. This expectancy-value model is defined in the following manner: A_B represents the attitude toward behavior B; b_i is the belief (subjective probability) that performing the behavior B will lead to outcome i ; e_i is the evaluation of outcome i ; and the sum is over the n salient beliefs. (Ajzen, 1988, p. 120).

$$A_B = \sum_N b_i e_i$$

Figure 2.2 The equation for the Expectancy-Value Model

Davis' initial adaptation of TRA produced a belief-attitude-intention-behavior relationship to an IT user acceptance model. Before the development of TAM, Davis suggested that research explaining user acceptance of IT had been constrained by a shortage of high-quality measures for key determinants of user acceptance (1986). He suggested that the development of improved measures for theoretical constructs was necessary for the field of information systems. A similar issue exists today in the field of

medical informatics. Physicians' and other healthcare practitioners' non-acceptance and laggard adoption of emerging technologies often baffle system developers and vendors. In pursuit of key measures for predicting and explaining system usage, Davis (1989) adapted the theory of reasoned action and subsequently the theory of planned behavior, when combined asserts that in order to understand human behavior, not merely to predict it, one must try to identify the determinants of behavioral intentions (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; Ajzen, 1985, 1991).

Several diverse lines of research, (Schultz & Slevin, 1975; Robey, 1979; Vroom, 1964; DeSanctis, 1983; Bandura, 1982; Hill, Smith & Mann, 1987; Beach & Mitchell, 1978; Johnson & Payne, 1985; Payne, 1982; Tornatzky & Klein, 1982; Rogers & Shoemaker, 1971; Larcker & Lessig, 1980; Swanson, 1982, 1987; Hauser & Simmie, 1981; Branscomb & Thomas, 1984; Card, Morgan & Newell, 1984; & Gould & Lewis, 1985) are responsible for the theoretical importance of perceived ease of use and perceived usefulness as key determinants of user behavior. Davis defines *perceived usefulness* as "the degree to which a person believes that using a particular system would enhance or improve his or her job performance" (1989). This follows from the definition of the word useful: "capable of being used advantageously."

Perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (p. 320). This follows from the definition of "ease": "*freedom from difficulty or great effort*". Davis (1989) further noted that perceived ease of use is an important influence upon an individual's usage of a system. Even if a potential user believes that a given application or system is useful, they may, at

the same time, believe that the system is too hard, difficult or cumbersome to use. Users may conclude that the performance benefits of usage are out-weighed by the amount of effort expended in using the application.

Davis successfully converged a wide range of theoretical perspectives to develop the measures of perceived ease of use (PEOU) and perceived usefulness (PU) from multiple disciplinary vantage points (1989, p. 323). TAM assumes that people tend to use or not to use an application to the extent they believe it will help them perform their jobs better. Multi-item measurement scales for the two constructs were developed, pre-tested, and validated in two separate empirical studies, all of which this chapter will describe.

Adams, Nelson and Todd (1992) replicated Davis' (1989) study and extended it to a different setting. Both scales appeared to have similar validity and reliability as Davis' original study. A decade earlier, Adams et al. (1992) summarized that there are a variety of ways in which Davis' measures are applicable. They contend that the TAM measures will more generally be relevant within and across organizations by researchers who are interested in understanding the diffusion of information technology adoption (1992). This research will test the recommendation of Adams et al. (1992) by utilizing TAM2 in the healthcare environment.

2.2.2 Scale development, testing and validation

The impact of perceived usefulness on system utilization is a strong concept within the work of Schultz and Slevin (1975) and Robey (1979). Davis (1989) discovered that these researchers conducted an exploratory factor analysis of 67

questionnaire items, which yielded seven dimensions. Of these, the 'performance' dimension, interpreted by the authors as the perceived "effect of the model on the manager's job performance," was most highly correlated with self-predicted use of a decision model ($r = .61$). Robey (1979) theorized that, "A system that does not help people perform their jobs is not likely to be received favorably in spite of careful implementation efforts" (p.537).

Davis also accumulated support of his constructs from Bandura's (1982) extensive research of self-efficacy. Self-efficacy is similar to perceived ease of use and defined as "judgments of how well one can execute courses of action required dealing with prospective situations" (p.122). Hill et al. (1987) found that both self-efficacy and outcome beliefs, a variable similar to perceived usefulness, exert an influence on decisions to learn a computer language. Davis (1989) maintains that self-efficacy research does provide one of several theoretical perspectives suggesting that perceived ease of use and perceived usefulness function as basic determinants of user behavior (p. 321). We believe that physicians will be more likely to adopt and use Internet-based Health Applications if said applications are perceived as both useful and easy to use.

Davis also examined the cost-benefit paradigm from behavioral decision theory (Beach and Mitchell, 1978; Johnson and Payne, 1985; Payne, 1982) and deemed it relevant to perceived usefulness and ease of use. This research explains managers' choices among various decision-making strategies in terms of cognitive tradeoffs between the efforts required to employ the strategy and the quality of the resulting decision. According to the researchers, this approach has been effective for explaining

why decision-makers alter their choice strategies in response to changes in task complexity. Davis believes that the distinction made between perceived usefulness and perceived ease of use is similar to decision making performance and effort; thus an appropriate theoretical perspective for his model.

To further support, his theory Davis considered research on the adoption of innovations. Complexity, as defined by Rogers and Shoemaker (1971) is “the degree to which an innovation is perceived as relatively difficult to understand and use” (p. 154). He believed that this concept parallels perceived ease of use quite closely.

Larcker and Lessig (1980) analyzed two items, which parallels with Davis’ TAM constructs. These items are:

- (1) *Perceived importance*, which is defined by the researchers as “the quality that causes a particular information set to acquire relevance to a decision maker,” and to the extent to which the information elements are “a necessary input for task accomplishment,” and
- (2) *Perceived usable ness*, which is defined as the degree to which “the information format is unambiguous, clear or readable” (p. 123).

The assertion is that the above dimensions are similar to perceived usefulness and perceived ease of use as defined, respectively. Swanson’s (1982, 1987) model of channel disposition explains the choice and use of information reports. The two components analyzed were attributed information quality (value) and attributed access quality (accessibility). Davis discovered that the items that load on these factors suggest a close

correspondence to perceived usefulness and ease of use. His investigation suggested that items such as 'important,' 'relevant,' 'useful,' and 'valuable' loaded strongly on the value dimension. Thus, they parallel perceived usefulness. Davis (1989) notes that several of Swanson's 'accessibility' items, such as 'convenient,' 'controllable,' 'easy,' and 'unburdensome,' correspond to perceived ease of use. Although Swanson's study was exploratory, with little to no construct validity, Davis claims it does agree with the conceptual distinction between usefulness and ease of use. The Hauser and Simmie (1981) marketing study revealed two underlying dimensions: ease of use and effectiveness, the latter being similar to the perceived usefulness construct.

The diversity of literature used to compile these constructs is impressive. Davis (1989) presents a perceptive link among the wide range of theoretical perspectives and research studies discussed as illustrated in Figure 2.3. The measures of perceived ease of use and usefulness are successfully developed from a multiple disciplinary vantage point (p. 323). However, early on he recognized that these were not the only variables of interest in explaining user behavior. However, Davis (1989) was convinced that previous literature indicated that *perceived ease of use* and *perceived usefulness* are fundamental and distinct constructs. We contend that these constructs are still, influential in decisions making in reference to intention to use information technologies. TAM will no doubt continue to be effective as a technology acceptance theory. We also maintain that testing TAM2's ability to predict physicians' intention to adopt and use Internet-based health applications will promote future discussion about its robustness and possibly strengthen its position.

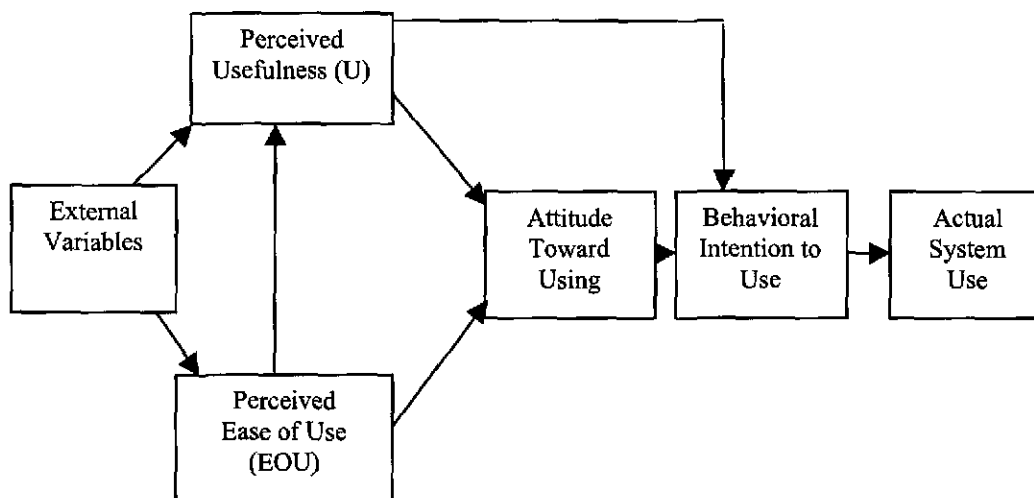


Figure 2.3 *Technology Acceptance Model (TAM)*
Davis, Bagozzi & Warshaw (1989)

A rigorous systematic process was applied to develop the new multi-item scales. The conceptual definitions of perceived usefulness and perceived ease of use as previously discussed, were used to generate 14 original candidate items for each construct from the past literature previously discussed (1989). After the pre-test interviews were conducted to assess semantic content of the items, the scales were refined to 10 items per construct. Davis then conducted a field study and a laboratory study to further fine-tune his scales.

First, a field study (study 1) was conducted to assess the reliability, convergent validity, discriminant validity, and factorial validity of the 10-item scale. A sample of 120 computer users within IBM Canada's Toronto Development laboratory were given a questionnaire asking them to rate the usefulness and ease of use of two systems available

there: PROFS electronic mail and XEDIT file editor. Responses were retained from 112 participants, for a response rate of 93%. Davis (1989) reports that the perceived usefulness scale attained Cronbach alpha reliability of .97 for both the electronic mail and XEDIT systems, while perceived ease of use achieved a reliability of .86 for electronic mail and .93 for XEDIT.

The usefulness and ease of use scales were refined and streamlined based on results from Study 1 and then subjected to a second round of empirical validation in Study 2. Davis applied the Spearman-Brown prophecy formula to the .97 reliability obtained for perceived usefulness, which indicated that a six-item scale composed of items having comparable reliability would yield a scale reliability of .94. The five positive *ease of use* items had a reliability of .92. Taken together, these findings from Study 1 suggest that six items would be adequate to achieve reliability levels above .9 while maintaining adequate validity levels. Base on the results of the field study, six of the 10 items for each construct was selected to form modified scales (p.328).

Secondly, a lab study (study 2) was conducted to evaluate the six-item usefulness and ease of use scales resulting from scale refinement in Study 1. The lab study involved 40 voluntary participants who were MBA students at Boston University. They were paid \$25 for participating in the study. The subjects were used because they filled the function of representative users, who could rate the future usefulness and ease of use they would expect base relatively little experience with systems being rated. Davis was especially interested in the properties of the usefulness and ease of use scales when they were worded in a *prospective sense and were based on limited experience with the target*

system. This is of particular interest for this research. It is important to examine the properties of the constructs and their relationship to physicians' intention to use the Internet in their clinical environment.

The study involved evaluating two IBM PC-based graphic systems: ChartMaster® and Pendraw®. The subjects were unfamiliar with the two systems used in the study. For further description of the products, see (Davis, 1989 p. 330). The participants were given one hour of hands-on experience with ChartMaster® and Pendraw®, using workbooks that were designed to follow the same instructional sequence as the user manuals for the two products, while equalizing the styles of writing and eliminating value statements (e.g., "See how easy that was to do?"). Half of the subjects tried ChartMaster® first and the remaining half tried Pendraw® first. After using each package, a questionnaire was completed.

Davis' statistical analysis yielded a Cronbach alpha of .98 for perceived usefulness and .94 for perceived ease of use. A detailed description of the statistical findings can be found in his paper (Davis, 1989, p. 331). The purpose of his investigation was to develop and validate new measurement scales for perceived usefulness and ease of use. His efforts were successful as the new scales were found to have strong psychometric properties and to exhibit significant empirical relationships with self-reported measures of usage behavior. As hypothesized, both perceived ease of use and usefulness were significantly correlated with self-reported indicators of system use.

One of the most significant findings was the relative strength of the usefulness-usage relationship compared to the ease of use-usage relationship. Davis asserts that

users are driven to adopt an application primarily because of the functions it performs for them, and secondarily for how easy or complicated it is to get the system to perform those functions (p. 333). For the purposes of our investigation, we are also examining if potential adopters (physicians) are more interested in the usefulness of a product in relationship to their intention to use it in delivering quality healthcare rather than the ease of use of that product.

Davis cautions that perceived usefulness and ease of use are people's subjective appraisal of performance and effort, respectively, and do not necessarily reflect objective reality. Even if an application would objectively improve performance, if users do not perceive it as useful, they are unlikely to use it (Alavi and Henderson, 1981). Although, the constructs (PU and PEOU) have been sufficiently and empirically tested for overall explanatory power and measurement validity, early on Davis recognized that these were not the only variables of interest in explaining user behavior. Venkatesh and Davis contend that a better understanding of the determinants of perceived usefulness would enable researchers to design organizational interventions and increase user acceptance/usage of systems (2000).

For more than a decade, TAM has continued to emerge as a parsimonious model for predicting user acceptance of information systems and information technologies, (Davis, 1989, 1993; Moore & Benbasat, 1991; Davis, Bagozzi, & Warshaw, 1989; Mathieson, 1991; Adams, Nelson & Todd, 1992; Taylor & Todd, 1995; Chin & Todd, 1995; Davis & Venkatesh, 1996; Doll, Hendrickson & Deng, 1998; Gefen & Straub, 1997; Hendrickson, Massey & Cronan, 1993; Igarria, Zinatelli, Cragg, & Cavaye, 1997;

Segars & Grover, 1993; Straub, Keil, & Brenner, 1997; Subramanian, 1994; Szajna, 1996; Jackson, Chow, & Leitch, 1997; Karahanna, Straub & Chervany, 1999; Venkatesh, 1999; Venkatesh & Morris, 2000; Venkatesh & Davis, 2000).

2.3 Technology Acceptance Model Studies

This section surveys TAM based studies in a chronological order. Although most research papers discuss only the most current literature, it is important to paint a complete picture of the evolution of and possibly the franchising of the technology acceptance model. In order to show how previous TAM studies contribute to this dissertation, we have made a conscious decision to discuss in sufficient detail the content, methodology, findings, implications, and the technical flaws of former studies using TAM as far back as 1989. The present investigation will move beyond previous TAM research by testing TAM2 in a healthcare environment. We will also contribute to the wealth of TAM and IS literature by evaluating past research and mirroring successful techniques, while avoiding previous pitfalls.

TAM, introduced by Davis (1986) in his dissertation, is an information systems model adapted from TRA to specifically explain computer usage behavior. In 1989, Davis, Bagozzi and Warshaw empirically examined the ability of TRA and TAM to predict and explain user acceptance and rejection of computer-based technology. Their primary interest was to show how well predictions could be made about future use of a system after simple measures were taken following a brief interaction with the system. The study proposed these research questions:

1. How well do intentions predict usage?
2. How well do TRA and TAM explain intentions to use a system?
3. Do attitudes mediate the effect of beliefs on intentions?
4. Is there some alternative theoretical formulation that better accounts for observed data? (p. 989).

Question number 2, is quite similar to the premise of the present study. We ask, “Can the extended technology acceptance model predict pediatricians’ behavioral intention to adopt Internet-based health applications”? As hypothesized, the results of the Davis, Bagozzi and Warshaw study suggests that TAM explained 47% and 51% of the variance at time periods, one and 2 respectively (1989, p. 993). Usefulness had a strong effect in both time periods ($\beta = 0.55$, time 1; $\beta = 0.48$, time 2), while ease of use had a significant direct effect on behavioral intention (BI) over and above attitude (A) and SN in time period 2 but not in time period 1. The study yielded the following overall insights:

1. People’s computer use can be predicted reasonably well from their intentions.
2. Perceived usefulness is a major determinant of people’s intentions to use computers.
3. Perceived ease of use is a significant secondary determinant of people’s intentions to use computers (Davis et al. 1989, p. 997).

Two years after the Davis et al. (1989) publication Mathieson (1991) systematically compared TAM and the Theory of Planned Behavior (TPB) models. Both models designed to predict an individual’s intention use an IS were compared on three criteria. First, how well they each predict the user’s intention to use an IS. Second, how valuable is the information provided by both models? Third, how difficult are the models to apply? Mathieson (1991) hypothesized that answers to the above questions would help to decide whether the models were useful and the conditions under which one model

might be more useful than the other. Mathieson's approach included describing both models, conducting an empirical study and presenting the results. Because this research has thoroughly discussed the TAM, we simply refer you to the beginning section of the literature review for its description.

The TPB is an extension of TRA. According to Ajzen, (1985), the theory is described in the following manner; behavior is determined by intention (I), to perform the behavior. Intention is predicted by three factors attitude (A), toward the behavior, which is similar to the concept of TRA, subjective norms (SN), and perceived behavioral control (PCB), the latter, which is not included in TRA. *Attitude and intention were defined as in TAM (Davis, et al. 1989), subjective norm is now included in TAM2 (Venkatesh, et al. 2000), which is a construct that we examine for our research. Continuing with Mathieson's (1991) study, PCB is defined as an individual's perception of his or her control over performance of the behavior; and depends on control beliefs and perceived facilitation (Ajzen, 1991). The cognitive control belief measures the likelihood that a person has the skills (efficacy), resources and opportunities believed necessary to execute the behavior. The perceived facilitation construct measures how important the skills, resources and opportunities are for the successful performance of the behavior.*

Mathieson contends that there are three main differences between TAM and TPB. The first is their varying degree of generality. TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of intention to use (1991, pp. 177-178).

Apparently this was a deliberate decision for Davis et al (1989), because they wanted to use “a belief set that . . . readily generalized to different computer systems and user populations” (p. 988). TPB uses beliefs that are specific to each situation (Figure 2.4). While there are concerns with TAM that variables other than ease of use and usefulness could predict intentions, TPB is more difficult to apply across diverse users context.

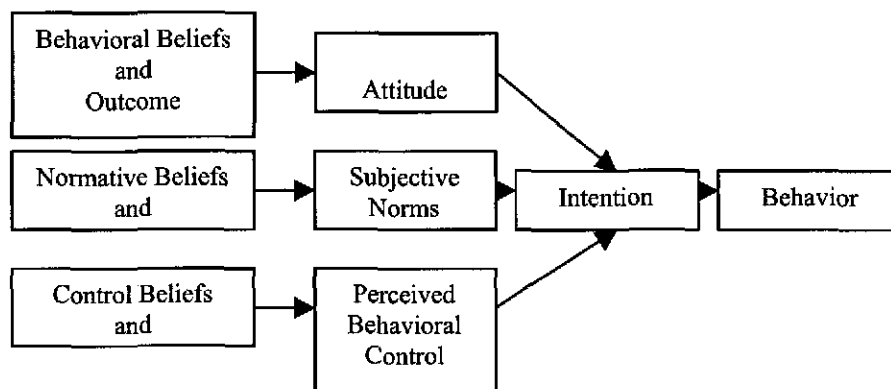


Figure 2.4 The Theory of Planned Behavior
(Ajzen 1985, 1991)

TAM’s constructs are measured in the same way in every situation where TPB requires a pilot study to identify relevant outcomes, groups and control variables (Mathieson, 1991, p. 178). The second major difference that Mathieson identified was that TAM did not include any social variables in 1991, where as TPB included subjective norms. Today, TAM2 has incorporated social and cognitive influences. The third difference was that both models treated behavioral control differently. TPB captures important control variables for each situation independently and is more likely to gather situation-specific factors. TAM however, relied on ease of use as its behavioral control items.

TAM is less likely to identify idiosyncratic barriers to use. This is in keeping with the stated objective of Davis et al. (1989) to develop a cooker-cutter model that is applicable across many situation, but will cause the model to miss control issues that are important in particular contexts (Mathieson, 1991, p. 179).

To test the models, Mathieson (1991) selected 262 subjects from an introductory management course. The subjects were given a task, which they could complete with a computer or calculator. Data were gathered using two computer programs, one administered TAM's instrument while the other administered TPB's instrument. The results showed that TAM was successful in explaining intention. The results were reportedly similar to that observed in Davis et al. (1989) and Davis (1989), with intention being affected more by usefulness than attitude and attitude being affected more by usefulness than ease of use. TPB had similar results. Intention was predicted by attitude and PBC, but not by SN. Apparently, the social pressures did not influence individual's decisions to use a spreadsheet. *Attitude had a slightly stronger effect on intention than PBC.* Overall, both models predicted intention well, although TAM explained slightly more variance than TPB and explained attitude much better than TPB.

The Information Systems Research journal also published an article in 1991, which utilized constructs of the TAM. Moore and Benbasat (1991) developed a 38-item instrument consisting of eight scales to examine users' perceptions of adopting an information technology innovation. The instrument intended for the study of the initial adoption of IT by individuals in organizations included Davis' (1986, 1989) ease of use

and usefulness constructs. While using the scale development process of the technology acceptance model, the study was also heavily grounded in the diffusion of innovation theory (Rogers, 1983). After four iterations of item sorting, the scales were pilot tested twice, then administered as a field test to 800 questionnaires were distributed to seven companies from a variety of industries. Moore et al. (1991) incorporated several constructs that are present in the extended technology acceptance model (Venkatesh et al. 2000). A list of the Moore et al. (1991) constructs are as follows, an asterisk indicates the constructs that were recently adapted for the TAM2:

Relative Advantage is defined as “the degree to which an innovation is perceived as being better than its precursor”.
**This construct is very similar to Davis’ perceived usefulness construct (1989). Mathieson contends that while Davis does not use the term “relative advantage” the definition is the same as that of “perceived usefulness” (1991, p. 198).*

Compatibility is defined as “the degree to which using an innovation is perceived as being consistent with the existing values, and past experiences of the potential adopter.”

**Ease of Use, is defined as “the degree to which an innovation is perceived as being free of effort.”*

Trial ability is defined as “the degree to which the potential adopter can experiment with the innovation prior to adoption.”

**Image, is defined as “the degree to which using an innovation is perceived to enhance image or status in the potential adopter’s social system”. An example would be a physician who uses a PDA because other physicians in their social system use PDA’s.*

**Result Demonstrability, is defined as “the degree to which the results of using an innovation are tangible (e.g., results*

are real or concrete and the user is able to communicate these results to others).”

*Voluntariness, is defined as “the degree to which use of the innovation is perceived to be voluntary, or of free will.”

Visibility is defined as “the degree to which the innovation is visible to the potential adopter and the degree to which the results of an innovation are visible and communicable to others”. This construct was initially labeled *Observability*, which is defined as “the degree to which the results of an innovation are observable to others.”

The overall results of this study yielded several contributions. The first is the creation of an instrument that can measure various perceptions of using and IT innovation. Second, this instrument can be used to examine how perceptions affect individuals’ actual use of IT and third the instrument development process further demonstrated the validity and reliability of the two scales imported from Davis (1986).

Continuing with our chronological assessment of TAM related research, Adams, Nelson and Todd (1992), replicated the technology acceptance model with two studies evaluating the psychometric properties of the ease of use and usefulness scales. Adams et al. also examined the relationship between ease of use, usefulness and system usage. The purpose of the study was to test the validity of ease of use and usefulness scales using independent samples for a variety of technologies (1992, p. 228). The technologies used in the first study included electronic mail and voice mail. Word processing, spreadsheets and graphics were the technologies used in the second study. The decision to use diverse technologies was to test Davis’ assumptions that the ease of use and usefulness scales was applicable across products/technologies (1989). We adapted this

rationale to test the TAM2 in a diverse environment, utilizing general healthcare information technologies. Our findings, like those of this study will only serve to better understand user's perceptions as well as add to the validity and reliability of the TAM2 constructs.

The measurement scales used for the first study were adapted from Davis (1989). The items were reworded to fit the technology used in the study and only two items were omitted the instrument. Those deleted were item four, regarding flexibility and item five referring to ease of use and skillfulness. Usage was measured in this study differently from Davis', which asked for self-reported measures of actual use. Adams et al., asked respondents to record the number of messages they had sent and received on the previous work day, as well as the number they sent and received on a typical day (1992, p.229). Two hundred and sixty surveys were distributed in 10 organizations, of those 118 returned for a response rate of 45 percent. Data analysis results showed that usefulness and ease of use scales showed high levels of reliability – Cronbach's alpha was 0.94 and 0.88 respectively for e-mail and 0.93 and 0.81 respectively for voice mail. Adams et al., values were comparable to the values reported by Davis (1989), which were 0.97 and 0.86. The reliability was confirmed as strong correlations for items belonging to the same scale were reported (1991, pp. 230-232). The correlations between ease of use, usefulness and usage were also consistent with that reported by Davis (1989) and Davis, et al. (1989) that ease of use is not as important as a determinant of usage or intention to use as perceived usefulness. However, the authors note that while ease of use may not be as important to the level of use of a system, it may influence the initial adoption of a

system. Overall, the relationship of ease of use and usefulness to usage was consistent to that of previous studies.

The second study of Adams et al. (1992) assessed ease of use and usefulness by examining users' ratings of WordPerfect, Lotus 1-2-3 and Harvard Graphics. The same scales were used as in study 1 except two additional ease of use items were added making the ease of use scale equivalent to that used by Davis in 1989. Usage was self-reported and measured in two ways:

1. Respondents rated their usage on a six-point scale from not at all through daily.
2. Respondents reported how many hours they had used each package within the last week.

Seventy-three questionnaires were returned from MBA and undergraduate students. Data analysis reported that the usefulness and ease of use scales showed high levels of reliability with Cronbach's alpha above 0.9 for both scales. Further both scales showed good convergent and discriminant properties, which added further evidence of the convergent validity of ease of use and usefulness scales (p.238). In spite of the inconsistencies between models in terms of the relative importance of ease of use and usefulness, overall Adams et al. found that Davis' (1989) scales fared well in their replication (1991, p. 239). They caution however that although the TAM appears to be robust across studies and user groups it should not be considered the final chapter in the validation and refinement of the ease of use and usefulness scales (p. 245).

Another TAM related study published by the *Journal of Applied Social Psychology* during the early 1990's examined the impact of enjoyment on usage intentions (Davis, Bagozzi and Warshaw 1992). The purpose of this study was to compare the influence of perceived usefulness and enjoyment on intentions to use computers in the workplace. The setup of this research was very similar in way of methodology and technology uses as Davis, et al. (1989). The contributing difference is the implementation of motivational theory, involving extrinsic and intrinsic motivation toward individuals' usage intentions.

According to (Lawler & Porter, 1967; and Vroom, 1964) extrinsic motivation refers to the performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job productivity. Davis et al., (1992, p. 1112) identify this definition as an example of perceived usefulness. Intrinsic motivation on the other hand, refers to the performance of an activity for no apparent reinforcement other than the enjoyment of performing the activity (deCharms, 1968; White, 1959). This definition fits with the study's construct of enjoyment. Davis et al., hypothesized that enjoyment would explain significant variance in usage intentions beyond that accounted for by usefulness alone (1992, p. 1113). They further hypothesized that ease of use and output quality would function as antecedents or precursors of both usefulness and enjoyment. To test the four hypotheses under investigation, two independent studies were conducted. The participants of study number (1) were 200 MBA students, of which 120 were male and 80 female, at a Midwestern University. A word processing program, WriteOne®, was the technology used and was

made available for volunteer use by the students in public computer laboratory a questionnaire concerning WriteOne® was administered at the end of the students at first 14-week semester. Again, Davis et al. (1989; 1992) used students as their subjects, which in our opinion decreases the generalizability of the results. Understandably, the average MBA student is employed, therefore this adds to the credibility of the findings being applicable to the target audience (individuals using the technology in the corporate sector) *the mere fact that the subjects are students, leads one to believe the subjects were chosen out of convenience.* We selected this model for our research because it provides a quick and inexpensive way to gather general information about individual's perception of an innovation. According to Mathieson (1991), TAM can be used to measure general levels of satisfaction across a range of users, *physicians included*, with diverse interests (p. 187). We hope to increase generalizability and avoid the loss of practical application by testing TAM in a setting natural to our subjects (e.g., field study) and utilizing *applicable technology that can be used at the point of care by physicians.*

The results of study 1 reported Cronbach alpha reliability coefficients as .91 for usefulness, .81 for enjoyment, .88 for ease of use, and .78 for output quality (Davis et al., 1992, p.1117). The 2-item measure of intention returned a Cronbach alpha reliability of .88. Hypothesis 1 was supported as usefulness and enjoyment had significant effects on intentions to use WriteOne®. Hypothesis 2 was also supported as intentions fully mediated the effect of usefulness and enjoyment on self-reported usage behavior. As predicted, Hypotheses 3 and 4 were supported; usefulness and enjoyment mediated the effects on ease of use and output quality on intention, and however ease of use was not

significant when intention was regressed on quality and ease of use. Davis et al, contend that ease of use and quality influence intention entirely indirectly via their significant effects on usefulness and enjoyment (1992, p.1120).

Study number 2 was conducted at an eastern university and the subjects were 40 evening MBA students, who were paid an incentive of \$25.00 to participate. The subjects evaluated and used two IBM-PC based graphic systems: Chartmaster® and Pendraw®, both technologies used in previous studies (Davis, 1989; Davis et al., 1989). After each program, a questionnaire was completed. The observations from both technologies were pooled expanding the sample size to 80.

Again, the results showed high Cronbach alpha reliability for usefulness at .97 and .92 for enjoyment. Ease of use and output quality reported .95 and .69 Cronbach alpha respectively. Consistent with the first study, Hypotheses 1, 3 and 4 were supported. However, Davis et al. report that Hypothesis 2: “Usage intentions will mediate the effect of usefulness and enjoyment on usage behavior” could not be tested because usage was not measured in study 2 (1992, p. 1124). The behavioral expectation form of intention questioning, which Sheppard, Warshaw, and Hartwick (1989) and Warshaw and Davis (1985) have shown is more predictive of future behavior than a pure intention format was used in study 2. The usage intention statements were worded as: “Assuming Chartmaster® (Pendraw®) would be available on my job, I predict that I would use it on a regular basis in the future.” The statements were rated on a 7-point Likert scale with endpoints of likely/unlikely and improbable/probable. The outcome of this study suggests that insufficient satisfaction and enjoyment can undermine the adoption of

otherwise productive computer systems. The authors note that quality of work life is more than a secondary concern relative to productivity improvement (1992, p.1128).

Hendrickson, Massey and Cronan (1993) conducted a test-retest of the reliability of the perceived usefulness and perceived ease of use scales. The importance of their article is to show the stability and consistency of the TAM instrument via a test-retest methodology. The authors conducted two studies, one utilizing a file editor and electronic mail and the other using two different graphic software packages. The subjects were similar to the original TAM studies (Davis, 1989; Davis et al, 1989), undergraduate students, enrolled in an introductory computer course at a midwestern university. Following Davis' procedures, the subjects were given the TAM instrument at two separate points in time. The first administration was immediately after the introduction and use of the software and the second was after a three-day period. Hendrickson et al. (1993) note that the subjects continued to use the software during the three-day interval with no further instruction.

Consistency and reliability of the TAM scales were assessed in a similar manner to that of our research. The methods used were Cronbach's alpha, paired t-test and correlations. We however, also include a multiple regression models.

Hendrickson et al. reported an alpha coefficient of .98 for perceived usefulness, which was not surprising, considering similar results have been found for each study since the 1989 Davis et al study. Perceived ease of use had an alpha coefficient of .94. Reportedly, there were no significant differences found between the subscale means, although two individual items "Easier to do Work" and "Useful in Work" had difference

in the mean score for the spreadsheet package. A similar result occurred in for the sample using database management. Two individual items had significantly different means at (T1-T2) – “Enhance Effectiveness” and “Easy to Learn.” The authors do not discuss why these particular individual items may have had significant differences. Perhaps this was not the scope of the research – it was merely to establish that Davis’ (1989) instrument exhibited a high degree of test-retest reliability.

As we fast-forward several years, Venkatesh and Davis (1996) examined the antecedents of perceived ease of use. TAM was used to study the relationship between perceived ease of use and computer self-efficacy. This study allowed them to examine how perceived ease of use evolves with hands-on experience. The findings here will be provide implications to the present research, as we are not employing hands-on experience, however we are proposing a positive relationship between ease of use and usefulness. The authors conducted three experiments and found that users base their ease of use perceptions on computer self-efficacy before hands-on system use, regardless of the extent of procedural information given to them.

Lucas and Spitler (1999) conducted a field study of broker workstations using TAM as their core model to build upon by incorporating perceived system quality and norms. The model predicted that social norms established by managers and peers would be important predictors to use in conjunction with perceived ease of use and usefulness. However, they found no significant relationships between perceived usefulness and perceived ease of use and use. The results concluded that in a field setting, organizational variables such as social norms and the nature of the job were more

important in predicting use of technology than user's perception of the technology. Their findings were inconsistent with previous mentioned TAM studies.

However, two interesting studies that are close in context to the current study are (Hu, Chau, Sheng & Tam, 1999; Chau & Hu, 2002). The former study examined Hong Kong based physicians' attitudes toward the acceptance of telemedicine using TAM. This study reported relatively low proportions of variance explained by TAM and similar to the before mentioned study did not report a significant effect of perceived ease of use on attitude or perceived usefulness. The conclusion was that TAM was inappropriate for the highly professional subjects examined because physicians are characteristically different from the usual subjects examined in TAM research (students, clerical and administrative workers). Hu et al. (1999) also contend that cultural differences could have been a limiting factor in their results. They recommend future studies to test TAM using other professional populations or different IT. To this end, we examine Hawaii-based pediatricians' intention to adopt an information technology using the extended technology acceptance model. To our knowledge, no research has yet to published within this context.

Chau and Hu (2002) examined physicians' acceptance of telemedicine. Specifically the study examined and compared TAM and the TPB as well as a model, which integrated elements, derived from both TAM and TPB. The subjects were physicians who practiced at public acute-care tertiary hospitals in Hong Kong. The physicians represented ten medical specialty or subspecialty areas. The researchers distributed 1728 questionnaires, 408 usable questionnaires were returned for a 23.6 %

response rate. The overall results as reported by Chau and Hu (2002) suggest that TAM appeared to be better than TPB in this situation. The improved explanatory utilities anticipated from the integrated model were neither significant nor noticeable. The attitude and perceived usefulness variance accounted by TAM were identical to those by the integrated model. The authors reported that together perceived usefulness and perceived ease of use accounted for 36% of the observed variance in attitude. However, perceived ease of use explained only 1% of the variance in perceived usefulness.

Perceived usefulness appeared to be a significant determinant of attitude and behavioral intention in both TAM and the integrated model. However, perceived ease of use was insignificant in both models. The results indicated that perceived usefulness appeared to be the most significant factor affecting physicians' acceptance of telemedicine technology. The unexpected finding of no significance of perceived ease of use is inconsistent with previous TAM research. It is worth noting because it might signify fundamental differences between individual professionals and the typical technology user commonly examined in previous research. Despite the inconsistent results of insignificant influence of the perceived ease of use construct and the insignificant effects of subjective norms on intention, the researchers indicate that overall TAM was an appropriate model for explaining individual physicians' technology acceptance decisions.

One of the objectives of this research is to advance theory and publish findings in reference to TAM and physicians' intentions toward the adoption of IT that either support or refute previous studies (Hu et al. 1999; Chau & Hu, 2002).

2.4 The Extended Technology Acceptance Model (TAM2)

With the former studies in mind, demonstrating that TAM is not strongly supported within a field setting or completely applicable when examining healthcare professional, the authors felt that a better understanding of the determinants of perceived usefulness would enable them to design organizational interventions that would increase acceptance and usage of new systems. The primary goal of the research was to identify the key determinants of TAM's perceived usefulness and usage intention constructs, (Venkatesh and Davis, 2000) and to understand how the effects of those determinants change with increasing user experience over time with the target system. Figure 2.5 demonstrates TAM2 model, using TAM as the initial building blocks.

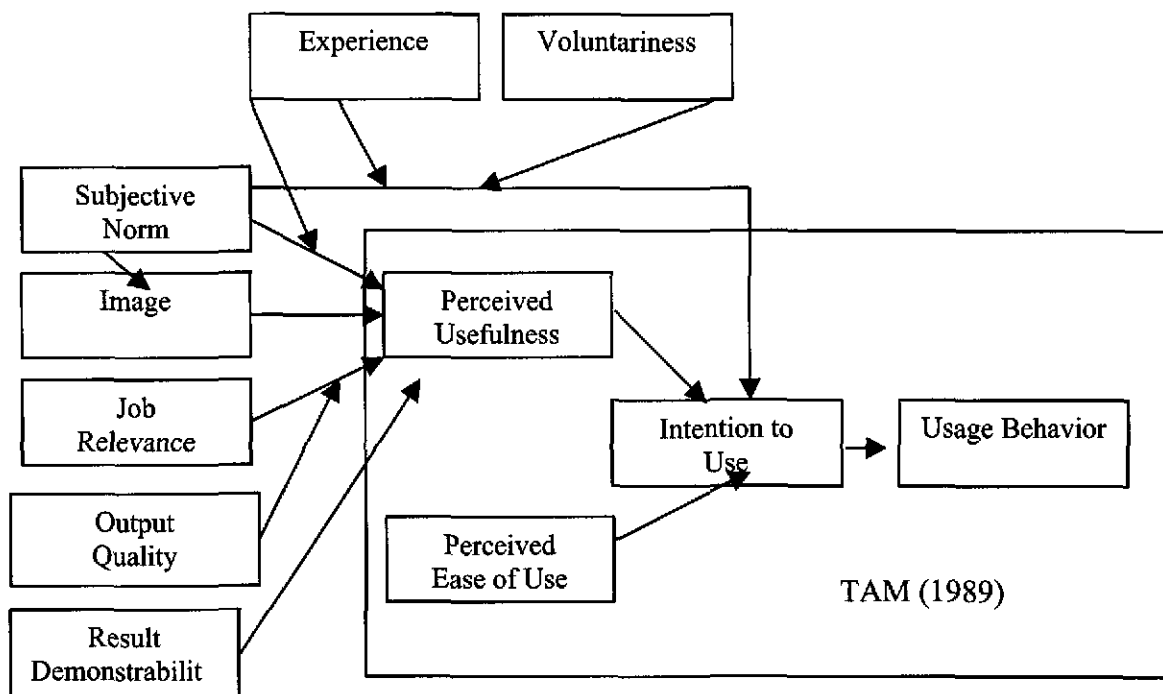


Figure 2.5. Extended Technology Acceptance Model
Venkatesh and Davis (2000)

Although TAM is based on the theoretical foundation of TRA, Davis (1989) did not include social and cognitive influence processes in the original theory. Incorporated into TAM2 are three interrelated social forces, which Venkatesh and Davis, (p. 187, 2000) contend impinges on an individual facing the opportunity to adopt or reject a system (subjective norm, voluntariness, and image). Also included in the extended model are cognitive instrumental processes (job relevance, output quality, result demonstrability and perceived ease of use). Venkatesh and Davis (2000) integrate social influence into TAM2 by using (SN) subjective norm, consistent with TRA.

SN is operationalized as an individual's perception that most people who are important to her think she should or should not perform the behavior in question (Fishbein & Ajzen, 1975, p. 302). SN is included as a direct effect in TRA and therefore in TAM2 as well. The rationale for this direct effect is that a person, for example, a physician, may choose to perform a behavior, such as using the Internet to submit prescriptions to the pharmacy. The physician performs this task even if he/she is not favorable toward the behavior or its consequences, if he/she believes that one or more important referents think that he/she should, and they are motivated to comply with the referents.

The direct compliance effect of SN on intention is theorized to function whenever a person (physician) perceives that a social actor wants him or her to perform a specific behavior, and the social actor (e.g., a fellow physician, peer or HMO manager) has the ability to reward the behavior or punish the behavior (French and Raven, 1959; Warshaw, 1980). Because of the mixed results found in examining the direct effect of subjective

norm on intention (Mathieson, 1991; Taylor and Todd, 1995; and Davis, et al., 1989), Hartwick and Barki (1994) examined voluntariness and compliance with social influence. They found that subjective norm had a significant effect on intention in mandatory settings but not in voluntary settings. They also discovered that even when users perceive system use to be organizationally mandated, usage intentions varied because some users are unwilling to comply with mandates. Ives, Olson and Baroudi, suggest that *increased user intentions are not always preceded by favorable attitudes, particularly when usage is not voluntary* (1983). An example of a situation would occur when a superior demands that a subordinate use a technology, such as the Internet to perform their work tasks. In this incident, a user is involuntarily committed to the use of the technology through direct managerial intervention, which is an amount of effort managers put forth to inspire use (Saga and Zmud, 1994).

TAM2 defines voluntariness as a moderating variable, the extent to which potential adopters perceive the adoption decision to be non-mandatory (Agarwal and Prasad, 1997; Hartwick and Barki, 1994; Moore and Benbasat, 1991). Although this study does not measure the voluntariness and mandatory factors, because the subjects do not use an actual technology, it is important to note that managerial intervention intensifies by initiating policy and rules for the IT, intention to use heightens. Manager intervention has shown to positively influence beliefs about usefulness (Lucas, Ginzberg and Schultz, 1990) and to positively increase intention to use (Leonard-Barton and Dechamps, 1988). Venkatesh and Davis (2000) reported a positive direct effect on intention when system use was perceived to be mandatory. Our subjects will not have

access to an actual mandatory system; therefore, we do not propose a direct relationship between subjective norm and intention. Presently, physicians are not compensated for their voluntary use of the Internet for remote medical consultations. Although, Internet use could possibly decrease unnecessary visits to the doctor's office or emergency room, health insurance providers have yet to implement a successful business model with policies for reimbursement.

Internalization (Warshaw, 1980) occurs when a person perceives that an important person or change agent (Rogers, 1983) thinks that he should use a system, that individual then incorporates the change agent's belief into his own belief structure. Identification refers to an individual's image within a social or work group. The authors of TAM2 theorize that subjective norms will positively influence image because, if important members of a person's referenced group believe that he/she should perform a behavior (e.g., using the Internet), then performing it tends to elevate their standings within the group (Blau, 1964; Kiesler and Kiesler, 1969). Rogers (1983) defines image as "the degree to which use of an innovation is perceived to enhance one's status . . . in one's social system." Kelman (1958) defines image, this source of social influence as identification, and distinguishes it from compliance and internalization.

TAM2 has borrowed from the theoretical foundation of previous research. The cognitive determinants come from (Vroom, 1964) work motivation theory; (Fishbein and Ajzen, 1975), action theory from social psychology and (Beach & Mitchell, 1978) task-contingent decision making from behavioral decision theory.

Moore and Benbasat (1991, p. 203) purport that even effective systems will not be accepted if people have a hard time attributing gains in their job performance that is specifically related to the use of the system. Result demonstrability is identified as the tangibility of the results of using the innovation. TAM2 posits that this factor will directly influence perceived usefulness. Agarwal and Prasad (1997) found a significant correlation between usage intentions and the construct result demonstrability. TAM2 asserts that the relationship between result demonstrability and perceived usefulness is consistent with the job characteristics model, which emphasizes knowledge of the actual results of work activities as a key psychological state underlying work motivation (Hackman and Oldham, 1976; Loher, Noe, Moeller and Fitzgerald, 1985).

TAM2 was tested using a longitudinal field study across four organizations (manufacturing, accounting, financial services and investment banking) utilizing four different systems. Two sites were chosen where usage was voluntary and two where usage was mandatory. Data were gathered using a questionnaire and the model constructs were measured at three stages across all four organizations: pre-implementation, one month post-implementation, and three months post-implementation, although social influence processes did not remain significant over time. Pooling across the four studies yielded a sample size of 156 per time period and pooling across the three time periods yielded a sample of 468. A limitation of the study was the small sample size in each organization, less than 50 per study. The small sample size explains the reduction the power of significance tests.

According to Venkatesh & Davis (2000) the extended model was strongly supported for all four organizations at all three points of measurement, regardless the small sample size, accounting for 40-60 percent of the variance in usefulness perceptions and 34-52 percent of the variance in usage intentions.

TAM2 was chosen for this dissertation as the theoretical foundation for several reasons. First, evidence shows that it is a robust and reliable theoretical model used across various technologies and in diverse situations. Second, it is economically feasible to use the measurement scales, which have been well tested and validated. Third, the findings of Hu et al (1999) were in consistent with the core TAM constructs; this research will provide an opportunity to evaluate TAM2 in a similar healthcare context. Finally, we wish to contribute to the literature of information technology adoption and the healthcare industry, specially addressing TAM2's applicability in predicting physicians' intentions to adopt Internet-based health applications.

CHAPTER 3

RESEARCH PROPOSITIONS

"The great tragedy of science -- the slaying of a beautiful hypothesis by an ugly fact."

-Thomas Huxley

3.1 Introduction

This chapter reiterates the research questions and puts forth the propositions for this study. The research questions were generated from both the IT and health care literature and the technology acceptance review of literature. *The Networking Health* (2000) and the *To Err is Human* (1999) reports presents and urgent need for the health care sector to adopt and use information technologies for the delivery of higher quality care. The Physicians Accessing the Internet Project, reported evidence that providing physicians with basic skills to access and use the Web can increase their use of the Internet (Chi-Lum BI et al, 1999). The results of the Hu et al (1999) study, recommended a need for more studies in the health care environment using TAM to compare their findings as well as to evaluate TAM's applicability in the health care context. The research propositions are adapted from the TAM2 study. The extended technology acceptance model has incorporated new antecedents to the construct of perceived usefulness, social influences and cognitive instrumental processes. We adapt the hypotheses of TAM2 to the test the model's pliability in the health care context. To our knowledge no such research applying TAM2 in the health care environment, addressing the specific issue of physicians' adoption of IHA has been published to date.

3.2 Research questions

The primary research questions of this study are listed below. It is important to note that the focus of this study is not on pure technology acceptance. Typically, physicians have already been exposed to or even employed the Internet for various uses, entertainment or personal communication. Therefore, the shift in use represents an adaptation of an existing technology coupled with unfamiliar Internet-based health applications to change the physician's perception of the strategic usefulness of the Internet. In chapter 4 we discuss the methodologies employed to assess the current use of the Internet by physicians, evaluate the effectiveness of the educational intervention and the testing of TAM2.

- 1) What is the current use of the Internet by physicians in Hawaii?
- 2) Can educational interventions affect physicians' intentions to adopt Internet-based health applications?
- 3) How applicable is the extended technology acceptance model to physicians' intention to adopt Internet-based health applications?

3.3 Research propositions

Based on the theoretical underpinning of the extended technology acceptance model (Venkatesh et al, 2000) the adapted research propositions are:

Proposition 1: *Subjective norms will have a positive effect on perceived usefulness.*

Proposition 2: *Image will have a positive effect on perceived usefulness.*

Proposition 3: *Job relevance will have a positive effect on perceived usefulness.*

Proposition 4: *Output quality will have a positive effect on perceived usefulness.*

Proposition 5: *Result demonstrability will have a positive effect on perceived usefulness.*

Proposition 6: *Perceived ease of use will have a positive effect on perceived usefulness.*

Proposition 7: *Intention to use measures taken after the educational intervention will differ significantly from those taken prior, to the intervention.*

Based on the diffusion of innovations literature, that has been incorporated into TAM2 we believe that physicians will show an increased intention to use the Internet if, however the Internet's usefulness is encouraged by a champion (Rogers, 1983). Venkatesh et al (2000) report that subjective norms can potentially influence intention indirectly through perceived usefulness. If a superior or co-worker suggests that a particular system might be useful, a person may come to believe that it actually is useful, and in turn form an intention to use it. (***Proposition 1***)

We propose that physicians will be positively influenced to use the Internet as a part of their clinical practice, if it is perceived to be important to referent members of their social and or work group. For this research, a well-regarded physician introduced the subjects to a method of incorporating the Internet and a personal digital assistant with medical software into their clinical practices. (*Proposition 2*)

We assert that subjective norms and image will have a significant impact on pediatricians' usage intention because of the professionalization (e.g., prolonged training in a body of specialized, abstract knowledge and orientation toward providing a service) of a physician. Oswald Hall (1948) points out that the decision to study medicine is largely social in character; that is, it originates in a social group, such as the family, that is able to generate and nurture the medical ambition. In a larger social construct, the medical profession is highly prestigious throughout the world (Quah, 1989). Physicians, make up a small percentage of the American workforce and generally control the conditions of which they work and the work of most of the other member of the health profession as well. Consequently, status and prestige, (which are factors of social influence in the TAM2 model), are afforded to them by the public and their medical profession colleagues (Cocherham 1998, p. 182). Also included in physicians' professionalization is the development of important or referent formal and informal relationships with colleagues in order to become recognized and accepted in their medical institution in a particular community (Hall, 1948, p. 330). We believe that these characteristics are ripe for testing the subjective norm variables, of TAM2.

The creators of TAM2 theorized beyond the social influences, which affect perceived usefulness and usage intention. The authors believe that people form perceived usefulness judgments partly based on cognitively comparing what the target system is capable of doing with what they need to get done in their job. Venkatesh and Davis, list these cognitive instrumental determinants as *relevance*, *output quality*, *result demonstrability* and *perceived ease of use*. Job relevance is defined here as an individual's perception regarding the degree to which the target system is applicable to their work. In respect to our study, it is important to note that job relevance is a function of the importance within one's job regarding the set of tasks the system is capable of supporting. In other word, physicians are likely to find the Internet useful, if it is relevant to the daily task of which they perform. (*Proposition 3*)

The second cognitive influence, output quality is of great interest to our study. TAM2 proposes that this factor takes consideration over and above that of job relevance. Physicians will take into consideration how well the system performs the task, rather than what task the system is capable of performing. (*Proposition 4*)

We contend that physicians will recognize the relationship between Internet usage and positive results in reference to their delivery of quality health care. However, the issue of remuneration may sway their opinion of usefulness, result demonstrability implies that physicians can be expected to form more positive perceptions of the

usefulness of the Internet if the mutual relationship between usage and positive results are immediately noticeable. (*Proposition 5*)

We cannot evaluate TAM2 without also examining physicians' general computer and Internet self-efficacy. We contend that perceived ease of use, is a direct determinant of perceived usefulness (Davis, et. al., 1989), the less effort expended in using a system, the more using it will increase job performance. We believe that the exposure to a target system will foster perceived ease of use, subsequently enhance perceived usefulness and intention to use. (*Proposition 6*)

Chi-Lum and Durkin (1999) report that by providing physicians with the basic skills to access the World Wide Web can increase their use of the Internet. We reason that an educational intervention or quasi-treatment will have a significant affect on physicians' intentions to adopt IHA. Venkatesh and Davis (1996) found that after subjects had hands-on experience with the target system, computer self-efficacy had a direct effect on perceived ease of use of the system. While our educational intervention does not provide hand-on experience, we contend that the exposure to the usefulness of IHA will have an affect upon intentions to adopt. (*Proposition 7*)

3.4 Theoretical research model

Figure 3.1 demonstrates the modified extended technology acceptance model illustrating the relationships and propositions that are tested in this study.

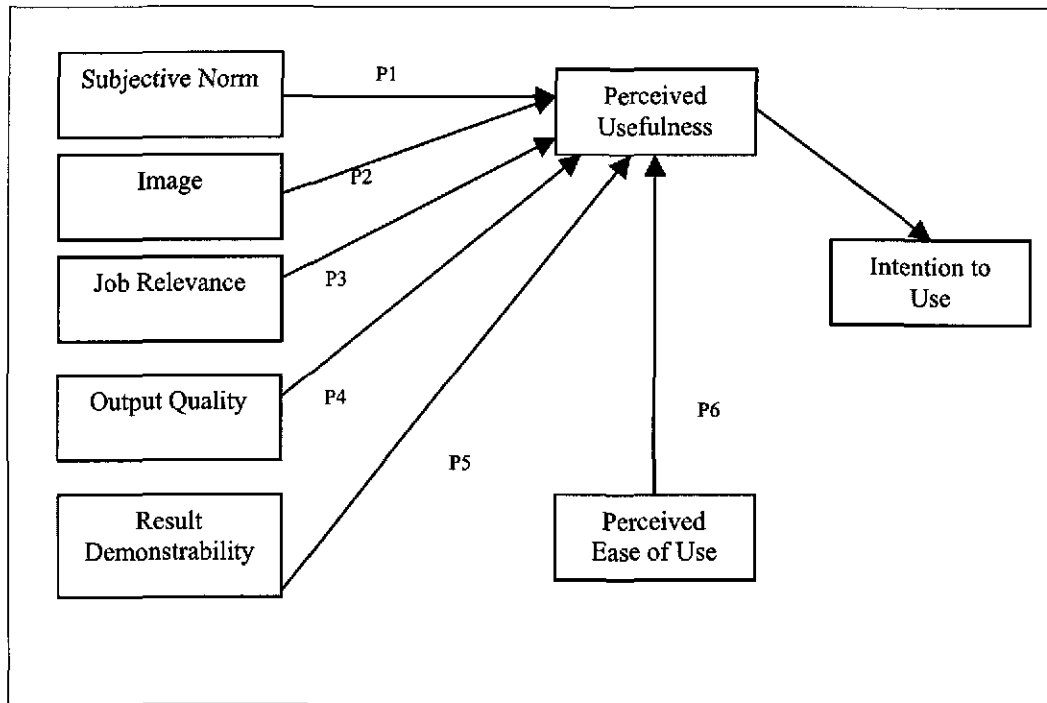


Figure 3.1. Modified TAM2 Research Model

In summary, we test the above propositions by applying the TAM2 to the condition of physicians' intentions to Internet-based health applications. We attempt to determine TAM2's applicability and robustness in this context.

CHAPTER 4

METHODOLOGY

“There is one thing even more vital to science than intelligent methods; and that is, the sincere desire to find out the truth, whatever it may be.”

-Charles Sanders Pierce

4.1 Introduction

This chapter reports the research methodology that was employed to address the research questions and to test the research propositions. We include a discussion on the choice of research design, setting, subject selection, questionnaire development, validation and administration. We also describe the initial pre-testing of the survey as well as, the test-retest method of reliability used here that has also been applied to other measurement instruments in MIS (Hendrickson, Massey & Cronan, 1993; Galletta & Lederer, 1989; Hawk & Raju, 1989; Torkzadeh & Doll, 1991). Section 4.6 illustrates the procedures executed for the educational intervention, while section 4.7, explains the collection methods used for the pretest and posttest questionnaire.

This research is a part of a larger study, which analyzes the IT adoption behavior of pediatricians in Hawaii. The focus of this dissertation is to evaluate the extended technology acceptance (TAM2) within the healthcare environment, using pediatricians as the subject test bed.

4.2 Research Methodology

In order to address the first research question; **“What is the current use of the Internet by physicians in Hawaii?”** The self-reported use of computers, the Internet, Internet-based health applications and demographic information were solicited from local area pediatricians. A survey derived from technology acceptance theory and IT and health care literature was developed for these measures. Modified and validated TAM2 scales were incorporated as a part of the pretest survey as well. The statistical frequencies procedure was used to obtain descriptive data, such as the mean, counts and percentages.

To address the second research question, **“Can educational interventions affect physicians’ intentions to adopt Internet-based health applications?”** invitations were issued to all practicing pediatricians to attend an educational lecture, sponsored by this research project and held at a local area hospital, after which a posttest survey containing modified TAM2 measures was mailed. Again, the frequencies procedure was used to obtain, counts, means and percentages. The Paired-sample T Test procedure was used to test whether the mean of casewise differences between two variables differ from zero. This procedure is useful in a study such as this with a before and after measure for pediatricians. Paired-sample T Test is an appropriate technique because we hope to measure each subject twice: before and after the intervention. The results will help to answer the research question as well as proposition 7.

For the third research question, “**How applicable is the extended technology acceptance model to physicians’ intention to adopt Internet-based health applications?**” multiple regression analyses using stepwise rotation were used to answer this question as well as to test the first six research propositions. We use the multiple regression technique because it is a statistical method for studying the relationship between a single dependent variable and one or many independent variables. For prediction studies, multiple regression analyses make it possible to combine many variables to produce optimal predictions of the dependent variable. In addition, we test the stability of the TAM2 instrument by applying the test-retest methodology to assess consistency and reliability. We also employ this technique because it is the method used in analyzing previous TAM research (Hendrickson, et al. 1993).

The following sections provide a detailed discussion of the research methodology used to answer the research questions and to test TAM2.

4.3 Research Design and Setting

In the interest of external validity, we selected a field study (*One Group Pretest - Posttest*). The field study consists of a pseudo or quasi-experimental design depicted in Figure 4.1. In field, research the investigator first looks at a social or institutional situation and then studies the relations among the attitudes, values, perceptions, and behaviors of individuals and groups in the situation (Kerlinger, 1986, p.332). The phenomenon here is pediatricians’ limited use of the Internet in their clinical practices. Our objective was to explore this issue by assessing pediatricians’ current perceptions and intentions to use Internet technology. Pedhazur and Schmelkin, (1991) refer to a

quasi-experiment as an investigation in which treatment(s) are administered but the subjects are not randomly assigned. Observations are made before and after the group is exposed to treatment via a survey. Utilizing surveys here provide greater external validity and are more conducive to the generalization of our results (Premkumar and King, 1994). We considered this methodological approach appropriate for measuring pediatricians' intentions to adopt IHA using the theoretically developed and well-validated TAM measures.

Although the *One Group Pretest-Posttest* design is frequently used in empirical research, we are aware of certain limitations, 1) there are no built in controls; 2) we cannot make general inferences outside of pediatricians in Hawaii and 3) there are threats to internal validity such as maturation, history, and mortality.



Figure 4.1: One-Group Pretest-Posttest Design

We believe the theoretical and practical need of our research will outweigh these limitations and our results will allow us to further IT acceptance theory and build a foundation for which we can conduct future studies on a much larger scale.

4.4 Subject Selection

Subjects were selected using the physicians' database from the Hawaii Chapter of the Academy of Pediatrics. All active members excluding residents, and retired pediatricians were solicited for participation. Due to the exploratory nature of the

research all pediatricians were invited to participate, rather than randomly selecting pediatricians from the HAAP list. Two hundred and five, pre-coded pretest questionnaire packets, were mailed on March 12, 2001.

4.5 Questionnaire Development Process

Theoretical constructs were operationalized using validated items from prior research (Venkatesh and Davis, 2000; PAI, 1999; Anderson, et. al., 1994), which were readily available for modification. Our questionnaire packet is an emulation of a various published surveys found in key health care, information systems, information technology, medical informatics, and telemedicine literature. Many validated instruments were studied in an effort to produce appropriate content as well as an appealing format for physicians (Physicians Accessing the Internet, Chi-Lum & Durkin, 1999; Managed Care Report Card-North Carolina Medical Society, Payton, 2000; Technology Acceptance Model 2, Venkatesh & Davis, 2000; Anderson & Aydin, 1997; Hu, Chau, Liu Sheng & Tam, 1999; Mairinger, Netzer, Schoner & Gschwendtner, 1998). The ultimate use of TAM2 to investigate pediatricians' IT acceptance was advantageous because of its well-tested and validated original measurement scales.

The extended TAM provided the opportunity to test the new constructs in a specific healthcare environment. TAM2 was adapted and tailored specifically for *pediatricians by soliciting suggestions via focus group from three local and three mainland-based pediatricians*. Changes made to the original TAM2 questionnaire consist of:

1. Exclusion of such variables as voluntariness, experience and usage behavior because we were not testing an actual technology or system; therefore voluntariness versus mandatory, experience and self-reported usage were not applicable to this study.
2. The inclusion of two additional questions to the output quality variable based on information ascertain from the physician-based focus group. Concerns of output quality regarding Internet-based health applications were pressing among pediatricians in the focus group.
3. Rewording of all sentences to incorporate the nomenclature of and the word pediatrician(s) to questions where applicable. This change was based on feedback from the pretest and pilot study, in order to increase interest by providing personal and professional appeal and thus enhance response rate.
4. Substituting the word “system” with IHA for Internet-based health applications or the Internet.
5. Changing the verb tense of some sentences to future tense rather than present tense. For example, the perceived usefulness and perceived ease

of use variables make assumptions that subjects have some experience with the technology in question. Discussions with physicians and the author of TAM assured us that it was appropriate to change the verb tense for the pretest because usefulness and ease of use is speculative, according to F. D. Davis (personal communication, January 25, 2001).

6. Reduction of the likertscale from a 7-point to a 5-point likertscale, where (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree). This reduction was made based on suggestions presented by the focus group and pilot test.

4.5.1 Construct operationalization

The measures for this dissertation were adapted and modified from TAM2 (Venkatesh et al, 2000). The instrument was tailored to the specifications of pediatricians to help establish content validity. A focus group consisting of practicing physicians and medical school professors, volunteered time and expertise to help reword and rephrase the existing TAM2 items garner specific appeal to physicians. Table 4.1 shows the modified measures used for this study.

Table 4.1. Modified TAM2 Measures

Intention to Use

Assuming, that significant barriers to the use of IHA are overcome, I intend to use IHA.
 If significant barriers did not exist, I predict I would use IHA.

Perceived Usefulness

IHA could increase my productivity.
 IHA could improve the quality of care that I deliver.
 IHA could enhance my effectiveness.
 IHA could be useful in my job.

Perceived Ease of Use

My interaction with IHA will be clear and understandable.
 IHA will be easy to use.
 Interacting with IHA will not require a lot of mental effort.
 It will be easy to get IHA to do what I want them to do.

Subjective Norm

Pediatricians who influence my behavior think I should use IHA
 Pediatricians who are important to me think I should use IHA

Image

Having IHA will be a status symbol.
 Pediatricians who use IHA have more prestige than those who do not.
 Pediatricians who use IHA have a high profile.

Job Relevance

Usage of IHA is relevant to the delivery of pediatric care.
 Usage of IHA is important to the delivery of pediatric care.

Output Quality

The quality of consumer health information on the Internet is high.
 The quality of pediatric information currently on the Internet is high.
 The quality of professional information on the Internet is high.
 I expect the quality of future IHA to be high.

Result Demonstrability

IHA could reduce the cost of my care delivery.
 I believe I could communicate to others the consequences of using IHA.
 The results of using IHA will be apparent to me.
 I would have difficulty explaining why using IHA may or may not be beneficial.

4.5.2 Pretesting of questionnaire

The instrument was field pretested by practicing medical and research physicians before the initial data collection phase. The field pretesting procedure was conducted using eight practicing physicians, one medical student, and six university professors from various disciplines. The pretest group was not a probability sample, since we do not plan to publish their findings. However, we attempted to make the pretest group as heterogeneous as the target population. Constructive feedback from these participants enabled us to reword, reformat, exclude, and include items specific to pediatricians in Hawaii. Field pretesting the questionnaire provided answers to the following questions:

- Does the level of language match the sophistication of the target population?
- Are instructions to the respondents clear? Are transitions smooth and informative?
- Are the questions and question format varied enough to retain respondents' interest and attention?
- Are the choice options to closed questions clear and exhaustive?

Further, the field pretesting process permitted us to gauge the length of the survey and time it took to complete. Additionally, we were able to obtain construct, face and content validity as well as reliability.

Overall, the field pretest helped us to develop a physician appropriate and "pediatrician-friendly" questionnaire. The initial instrument underwent eight drafts.

The final instrument consisted of six parts: *Current Use of Technology*, (*IHA*) *TAM2*-modified, *Barriers to Internet-based Health Applications*, *Personal View* (qualitative) and *Comments* (qualitative) and *Demographics* – totaling 124 items. This

research primarily focuses on the results of the TAM2 theory items. The overall instrument is a part of a larger and on-going study of physicians' adoption behaviors and use of information technology. Further analyses and for future research will be presented subsequent to the present study.

While the majority of the questionnaire is quantitative in measures, we have included some qualitative portions to allow for richer exploration for a future study. The complete pretest survey may be obtained by contacting the author.

4.5.3 Measurement scale: test-retest reliability

To assess the internal consistency and reliability of the measurement scale, Cronbach's alpha coefficients are chosen as the technique to calculate all of the subscales. A reliable scale consists of values exceeding 0.70, the acceptable range recommended by Nunnally (1978). Alpha is measured on the same scale as a Pearson r (correlation coefficient) and typically varies between zero and one. The closer the alpha is to 1.00, the greater the internal consistency of items in the instrument being assessed (George & Mallery, 2001). The stability of an instrument can be determined by using a test-retest procedure. The test-retest method involves multiple administrations of an instrument to the same people to assess the instrument's consistency and reliability. Our study examined the test-retest reliability of all eight subscales of TAM2 using pediatricians as the subjects, adding further evidence concerning the reliability of these scales particularly in the healthcare environment.

Subjects for the test-retest were 205 Hawaii-based practicing pediatricians. The *intention to use, perceived usefulness, perceived ease of use, subjective norm, image, job*

relevance, output quality and *result demonstrability* scales were administered via mail at two points in time. The initial instrument was administered (T1) on March 12, 2001. The second administration (T2) followed the first administration by 8 weeks to assess the reliability of the instrument. During the eight –week interval, subjects were invited to attend an educational intervention offering CME credits regarding the benefits and implications of using Internet-based health applications.

To assess the consistency and reliability of the scales, three methods were used – Cronbach's alpha, paired t-test, and correlation. Cronbach's alpha coefficients were calculated for all eight subscales for each administration (T1 and T2) of the instrument. Paired t-tests were conducted to determine difference in mean responses. Finally, Spearman correlation coefficients were calculated to assess the reliability of the individual items and subscales for both administrations (T1 and T2). Within this section we defined the test-rest methodology used to assess our instrument's internal consistency. The proceeding section details the overall procedures used in the execution of our study.

4.6 Procedures

We applied Dillman's (1978) total design method (TDM), which is intended to boost response rate for mail questionnaires. Dillman's idea is (a) to make the survey look easy to fill out, (b) to give social rewards for filling it out (e.g., giving thanks, according to the person's individual attention), (c) to establish trust by official sponsorship. TDM involves paying close attention to every detail of the questionnaire construction and implementation that would involve response rate. For example, we prepared our survey

as an 8½ x 11 double-sided, two-colored glossy bound booklet. The front cover was designed to attract interest, with a title, logo, and instructions. The back cover invited further comments and appreciation to the respondents.

Adhering to these principles and those of Bourque and Fielder, (1995) we attached endorsement cover letters from the president of the HAAP and the principal investigator of the research grant, to motivate and increase response rates. An added personal of the touch was individually hand signed letters explaining the purpose of the study, the importance of pediatricians' participation; provided a name, email and phone number to contact for further information. The appeal letters also provided personalized salutations and offered further explanations as to when, where and how to return the survey and provided a confidentiality clause. Extra incentives provided were a pre-addressed-stamped-envelope for survey return, a chance to win a Palm Pilot with medical and pediatric applications for those returning the survey by March 31, 2001, a flyer announcing continuing medical education (CME) credits for Internet-based health applications seminars and a complimentary CD-ROM featuring "Radiology Cases in Pediatric Emergency Medicine" provided by Dr. Loren Yamamoto (1999). See Appendix B for a copy of the appeal letters.

The self-administered surveys were mailed on March 12, 2001. To remind pediatricians to complete the survey, the investigator mailed a blue postcard two weeks afterwards. A green colored postcard was mailed four weeks after the initial mailing and follow-up phone calls were randomly placed to every 3rd non-responder at the sixth

week period and every 5th non-responder at the 7th week. A third and final coral colored postcard reminder was mailed eight weeks after the initial mailing. As surveys were returned, data were screened for missing values, and entered into an Excel® spreadsheet for preliminary descriptive analyses, afterwards data were exported to SPSS® for regression analyses. The statistical analysis process is further discussed in chapter five.

4.6.1 Intervention Procedure

In conjunction with the return of the initial surveys; email messages, bulletin board postings, website and automated fax blast announcements were sent to all pediatricians on the HAAP list to promote our CME credited seminar. As previously mentioned a key objective of this field study was to assess pediatricians' current perceptions and use of the Internet and to determine whether exposure to Internet-based health application seminar would have a positive affect on their intention to adopt Internet technology for their clinical practice. Because of our small sample population, and seemingly waning initial response rates, all pediatricians were invited to attend the educational intervention seminar.

Rarely do scientific investigations proceed smoothly in a neat sequence of steps. This is especially true of field research Singleton et al., (1999). Our major concerns were (1) selecting a naturalistic research setting, (2) gaining access to the setting, (3) presenting ourselves, (4) acquiring permission to offer continuing medical education credits, (5) retaining a peer-revered presenter and with appropriate IHA (6) gathering

information in the field, and (7) analyzing the information and theoretically interpreting the information.

We gained access to a local area hospital, where the intervention was conducted as a part of the routinely scheduled “Pediatric Grand Rounds.” CME credits for the seminar were granted which was appealing to the physicians. The participants pre-registered for the seminar and were required to sign-in to receive their CME credits. This approach allowed us to cross check our database for participants that had completed our initial survey. Over 40 pediatricians attended the seminar, however we did not administer the posttest immediately following and therefore missed an opportunity to gather information on the true effectiveness of the intervention. This limitation is addressed in chapter 6.

A well respected pediatric colleague, Richard N. Shiffman, MD, MCIS, from the Department of Pediatrics & Center for Medical Informatics, of Yale School of Medicine was our seminar presenter. Dr. Shiffman’s topic was “*Computer Assisted Clinical Decision Support in Pediatrics*”. Dr. Shiffman conducted the intervention using a lecture style format and a PowerPoint™ presentation regarding the AsthMonitor® a Newton™ Message pad handheld computer, which pediatricians can use at point-of-care. Shiffman’s main objective was to define computer-based decision support, introduce successful decision support applications, present issues in delivering decision support and address barriers to IHA adoption.

The technology presented was a pen-based personal digital assistant (PDA), which uses customized software, for structured documentation, recommendations,

prescription writing and calculation of medicine dosages. An illustration is shown in Figure 4.2.

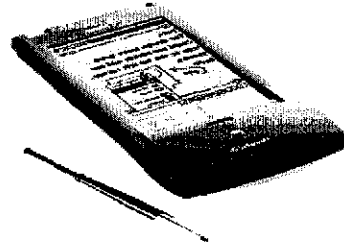


Figure 4.2: Newton Message Pad (PDA)

Shiffman presented a research study conducted using the AshMonitor®, the purpose of the study was to evaluate effects on the *process* and *outcomes* of care brought about by a handheld, computer-based system that implements the American Academy of Pediatrics (AAP) guideline on office management of asthma exacerbations. The primary hypothesis for the research was “Use of AsthMonitor will lead to improved adherence to the guidelines regarding: assessment of oxygen saturation, prescription of corticosteroid and use of oxygen” which was supported by the study’s results. Overall, the educational intervention gave participants an objective view of the advantages, disadvantages, and obstacles to the adoption of clinical decision supports systems and concluded with the interpretation that decision-support systems can lead to higher-quality care because they are effective, patient-centered, timely, efficient, equitable, and safe. In addition, the intervention provided local pediatricians an opportunity to receive information regarding Internet-based health applications from a non-local perspective.

One day following the seminar, a pre-coded 30-item survey with a SASE, was mailed to all pediatricians on the HAAP lists, excluding five pediatricians, three physicians of which informed us via the initial seminar that they were not pediatricians, rather specialists that happen to practice pediatric medicine. A fourth pediatrician emailed to say that she was on leave and the fifth had moved to the mainland since our initial mailing, however responded regardless. After deleting these five physicians from our master list, our target sample became 200. The posttest survey consisting of the TAM2 25-item scale and four questions referring to the respondents' participation in our research sponsored seminar or any other Internet based health seminar within the last six months.

4.7 Data Collection

Phase 1 data were collected via the return of the initial questionnaires. Phase 2 data were collected via posttest returns. Phase 1 and 2 data were also analyzed using the test-retest technique to assess the instrument's reliability. A second aim was to examine any affect of the intervention on pediatricians' intention to adopt IHA. Paired sample T-tests were used to compare mean differences for the before and after score of pediatricians that completed both the pretest and posttest as well as attended the educational intervention. As previously mentioned frequencies procedures were used to obtain counts, means and percentages of both pretest and posttest survey responses. Multiple regression analyses, was employed to test the research propositions.

In summary, this chapter reported on the methodology, research designed and statistical techniques used to answer the research questions and to test the research propositions. Chapter 5 presents the results of the test-retest, pretest, intervention and posttest analyses. Chapter 6 provides a discussion of the major findings, implications and limitations. Chapter 7 concludes with summary of the dissertation research and recommendations for future studies.

CHAPTER 5

RESEARCH RESULTS AND FINDINGS

"The problems that exist in the world today cannot be solved by the level of thinking that created them."

-Albert Einstein

5.1 Introduction

This chapter reports the statistical results for the dissertation. We discuss the survey response rate and non-response bias. In section 5.3, we present the descriptive statistics. Section 5.4 describes the results and findings to our first research question. In sections 5.5 through 5.7 we report the results of the test-retest measurement of reliability, pretest regression analyses and posttest regression analyses all of which were used to answer research questions and to test the research propositions. Section 5.10 highlights the results of additional regression analyses to determine if various factors other than those proposed by TAM2 influence adoption intention. The following statistical analyses were performed in this study.

1. Frequency computations were used to determine the current use of the Internet and cross-tabulations were conducted to measure differences across various demographic variables.
2. Test-Retest measurement reliability testing were used to assess the internal consistency and reliability of the scales, three methods were used - Cronbach's alpha, paired t-test, and correlation.

3. Paired-sample T Test were used to distinguish differences of mean scores for both the pretest and posttest respondents after the educational intervention.
4. Exploratory factor analyses were used to assess construct validity.
5. Multiple regression analyses were used to test the research propositions and to determine the applicability of TAM2 to predicting physicians' intentions to adopt Internet-based health applications.

5.2 Survey Response

Initially, 205 paper-based surveys were mailed to local pediatricians. Ninety-one surveys were returned during an eight-week period. Surveys returned prior to our first postcard reminder were coded as round one responders; surveys returned after each subsequent postcard or phone call reminder, were coded respectively, round 2, 3, and 4. This process was conducted for internal statistical purposes and for future survey research knowledge. Seventy-one percent of the sample responded within the first round, while 18% within the second round and 9% responded within the third round. Finally, 2% responded to our last postcard reminder closing out the fourth round of responders.

Of the 91 pretest surveys returned 89 were determined usable (i.e. yielding a response rate of 43.4%). To distinguish whether a completed survey was useable, we utilized a set of pre-defined criteria. Respondents of the pre-coded surveys must have completed certain demographic items (i.e., Age, Gender, Primary Location of Practice) and the TAM2 items because of the premise of the research.

Five surveys, not included in the response rate were returned either incomplete or not completed with notes from pediatricians stating that they were not currently practicing or have moved out of town. In this regard, several emails and phone calls were received from survey recipients who did not consider themselves pediatricians but rather, physician specialists who delivered pediatric health care. This distinction between medical disciplines presents an interesting issue that will be investigated in future research with reference to IT adoption and physicians in different medical fields.

5.2.1 Non-response bias

Non-response is a potential source of bias in survey studies and therefore needs to be properly addressed (Flower, 1993). The potential biases in this study were evaluated by comparing the demographic constructs of age and gender to determine if there is a significant difference between respondents or *sample* population and non-respondents (those that did not return the questionnaire) or our *target* population. *Note the procedure used to acquire the age of the non-respondents for comparison approximated the physicians' actual age. Due to our specialized target audience, we obtained the complete mailing list of all practicing pediatricians in Hawaii from the HAAP. Our demographic data were presented to HAAP and we were verbally informed that our sample was representative to their membership.

To this end, we examined each local hospital's web page and physician directory to locate the names, and demographic information of each non-respondent, below are the web sites that were used for this procedure.

http://www.hawaiiaap.org/haap_mds.html
<http://www.doctordirectory.com>

<http://www.kaiser.org>
<http://nt.kapiolani.org/>
<http://www.queens.org>
<http://www.straubhealth.com/>
<http://www.doctordirectory.com/hospitals/directory>

For our purposes, the most productive web site was DoctorDirectory.com. This web site gave the most complete information needed for our comparison. Some directories provided the gender and age criteria needed while others only provided gender and the pediatrician's date of medical school graduation and or date they first began practice, rather than their actual age.

Medical school graduates are 26 or 27, according to the Association of American Medical Colleges (http://www.hindunet.org/alt_hindu/1995_May_2/msg00038.html). We applied a formula to compute approximate current age for each non-respondent. An *Example*: Dr. Smith graduated medical school in 1978. If he or she were 27-years-old in 1978, then he or she is approximately 50-years-old at the time of our survey (2001-1978 = 23 + 27 = 50). We then placed the non-respondent in the age group (41-50) for a comparison of means with the survey sample. There was no statistical difference between the sample and target populations based on gender and age. Table 5.1 reveals the gender pattern of the respondents versus the non-responders, with forty-seven percent male and forty-four percent female for non-respondent pediatricians. Over 50% percent of the respondents were male while 42% were female.

Table 5.1. Gender of Respondents and Non-Respondent Pediatricians

Gender	Non Respondents		Respondents	
	N	%	N	%
Male	54	47	52	58
Female	50	44	37	42
Total	104	100	104	100

Less than 4% of the respondents were between 20 and 30 years old, and 19% of the respondents were over 60 years of age. Table 5.2 illustrates the ages of both the respondents and non-respondent pediatricians in Hawaii.

Table 5.2. Age of Respondent and Non Respondent Pediatricians

Age Range	Respondent		VS	Non Respondent	
	Frequency	Percentage		Frequency	Percentage
20-30	3	4		0	0
31-40	21	24		7	18
41-50	30	34		9	24
51-60	18	20		11	34
61+	17	19		9	24
Total	89	100		38	100

5.3 Descriptive Statistics

The survey data were entered into a database and verified twice, once, by an independent assistant. In addition, data were analyzed for missing values and outliers, using frequencies, the box and whisker and histogram functions in SPSS® 11.0 statistical software.

The respondents to our survey were representative of the pediatrician population in the US as reported by the American Academy of Pediatrics in its survey of members, with the exception of practice size (<http://www.aap.org/research/ps43aexs.htm>). The national average of solo pediatric practice is only 10.6%. Forty-two percent of pediatricians reported their primary form of practice as solo private practice, while only 6.7% indicate that they practice at an HMO. See Table 5.3. The large percentage of solo private practices in Hawaii warrants further investigation, in reference to its impact on physicians' attitudes toward and clinical use of information technology innovations.

Forty-nine percent of pediatricians reported working in small office settings with no more than one colleague. However, an interesting finding is 22.1% of pediatricians work in an organizational setting of 3-10 colleagues, while 20.9% reported working with 31 or more colleagues. Medium size organizations 11-15 and 16-30 showed smaller percentages of 1.2% and 7.0% respectively.

Table 5.3. Primary Form of Practice

Primary Practice	Percent of pediatricians
Solo Private	41.6
Single Specialty Group	11.2
Multi-Specialty Group	15.7
University-Base Hospital	7.9
HMO	6.7
Other	15.7

Looking at the data for pediatricians who selected "other" as their primary form of practice, we discovered a repetition of the categories listed here:

- Community Health Center
- Military/Teaching
- Military

- Locums/Hospitalists
- Public Health
- Administrative
- Rural Health Center
- Rural Underserved Health Center

Our analysis reveals that pediatricians are experienced with computers and the Internet. Twenty-five percent have one to five years of experience with computers. Thirty-two percent reported six to ten years of computing familiarity and 3.4% admitted to having no computer experience. See Table 5.4.

Table 5.4. Years of Experience with a Computer

Years of Computer Experience	Percent of pediatricians
None	3.4
Less than 1 Year	4.6
1-5 Years	25.3
6-10 Years	32.2
11-20 Years	25.3
Greater than 20 Years	9.2
Missing	2.2

In reference to personal use, 83% reported using a computer at least once a week and 67% reported using a computer everyday. With respect to the Internet, 74% of pediatricians access the Internet at least once a week for personal use and only 11% claim to have never used the Internet for personal reasons. Respondents listed the following web sites as some of those in which they most frequently visited:

American Academy of Pediatrics (www.aap.org)	PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi)
National Library of Medicine and National Institute of Health (www.nlm.nih.gov)	Medscape (http://www.medscape.com/px/urlinfo)
Center for Disease Control (www.cdc.gov)	Physicians on-line (http://www.med.yale.edu/yfp/referral/)
Medline (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi)	MD Consult (http://www.MDconsult.com)

Given the respondents' personal use of computers and the Internet it is not surprising that 45.6% indicate that they are moderately knowledgeable about computers and 48.3% report they are moderately knowledgeable about the Internet in general. Similarly, 34.5% report they are moderately knowledgeable about Internet-based health applications. Table 5.5 reflects pediatricians' knowledge of IHA in percentages.

Table 5.5. Knowledge of Internet-based Health Applications

Level of Knowledge	Percent of pediatricians
Novice	21.8
Slightly	32.2
Moderately	34.5
Very	9.2
Expert	2.3

Pediatricians reported that they are currently using a number of Internet-based health applications. Table 5.6 lists these applications along with the corresponding percentages.

Table 5.6. Internet-Based Health Applications Used by Pediatricians

Internet-Based Health Applications	Percentage Currently Using Applications
Medical Literature Searches	84.9
Professional News	68.6
Drug Information	43.0
Email with Colleagues	80.2
Email with Patients	25.6
Patient Education	37.2
Electronic Medical Records	14.1
Transmission of Non-Administration claims	10.5
CME	53.5
Access Academic Sites	59.3
Access Hospital Systems	17.4
Clinical Guidelines	43.0
Transmission of Claims	27.9
Patient Health Records	5.8
Purchasing Supplies	19.8
Access PDA Applications	16.3
Other	3.5

The greatest use of IHA here is in medical literature searches, email with colleagues and access to professional news at 85%, 80% and 69% respectively.

To this end however, Table 5.6 shows minimal use of patient health records and the fully functional electronic medical records, which has been highly sought after by industry.

Based on the data in Table 5.6, physicians reported having the most significant use of medical literature, professional news, peer communication, continuing medical education and access to academic information applications. These findings can be related to physicians' individual needs to ensure the appropriate educational requirements that drive the health care industry ("*Health and Medicine*," 2001).

In addition, our qualitative data indicates that communication and education for both patients and physicians are perceived as the key drivers regarding IT adoption and care delivery. For example, several pediatricians reported the following when asked what would they do if they could use the Internet or any other computer technology to improve the health of children in Hawaii:

“Better communication among pediatricians here on the island for consults/information...”

“Computer with pre-formatted programs in the waiting room. User-friendly programs to invite/entice patients to information regarding healthcare. Case studies, community epidemics, vaccinations schedules, resources for family health case - all these may be made available at the push of a key”

“Enhance patient education and consultations among providers”

“Higher health/patient information including Handouts, links, diagrams, dosing charts available at website accessible to school children who seek health information”

“Disseminate Information”

*“Pediatricians in Hawaii could produce a website with good general info for parents on child/medical care that we could recommend without worrying about its content (i.e. mercury issues, SIDS warnings, diet recommendations warnings of medical products, *immunization MYTHS ‘my biggest headache with parents these days)’”.*

“Use the internet or videoconferencing for education of Health Care Personnel especially Real Time Grand Rounds from Honolulu where we can earn CME credits”

5.4 Analysis for Research Question 1

To address this following question we used descriptive analysis to obtain the response frequencies and percentages for the pretest respondents on items (2-6 and items

10 and 12). When we asked Pediatricians to what degree they use the Internet in their daily work routine based on administrative, clinical, and personal categories, the response was quite favorable for everyday personal use, at 57%. Table 5.7 indicates pediatricians' responses in percentages. Thirty-five percent claim to use the Internet for clinical applications at least once per week. Twenty-two percent reportedly use clinical applications via the Internet everyday and interestingly, 39% report never using the Internet for administrative purposes.

Research Question 1: What is the current use of the Internet by physicians in Hawaii?

Table 5.7. Current degree of Internet use in work routine

	Never	Rarely 3 times/year	Occasionally Once/month	Often Once/week	Everyday
Administrative	39.1%	9.2%	9.2%	20.7%	21.8%
Clinical (all applications)	20.5%	5.7%	17.0%	35.2%	21.6%
Personal	11.4%	3.4%	11.4%	17.0%	56.8%

The percentages for the following questions were calculated to provide a glimpse of the current use of the Internet by pediatricians. Fifty percent are connected via dial-up modem, 47% claim that their practice has a website and 40% reportedly refer their patients to sources on the Internet.

How do you connect to the Internet from your office? (Check All that Apply)

- a. (49.1%) Dial-up (telephone) Modem
- b. (7.0%) Cable Modem (e.g. roadrunner)
- c. (5.8%) DSL (Digital Phone)
- d. (30.2%) Local Area Network (LAN)
- e. (10.6%) Not Sure

Does your practice have a site on the Internet? (47%) Yes ξ No (53%)

What Internet resources or sites do you most commonly use, if any?

30.9% indicate 1 site
32.7% indicate 2 sites
18.2% indicate 3 sites
10.9% indicate 4 sites
1.8% indicates 5 sites
3.6% indicate 6 sites
1.8% indicates 13 sites

Do you refer patients to sources on the Internet? (40%) Yes ξ No (60%)

Pediatricians are optimistic about the amount of time in which they predict it will take for Internet-based health applications to become common practice. Based on the results our data indicates that pediatricians' currently have positive attitudes toward the adoption and use of IHA. Ninety percent of the pediatricians predict that email with colleagues will become common practice in less than three years, while 67% and 75% predict that email with patients and transmission of claims respectively, will become common in pediatric practices in less than three years.

This dissertation is a part a larger study that examines physicians' use of the Internet in their clinical practices. Using data collected as a part of this research Chismar (2002) investigated the differences in current use of the Internet across three demographic variables: physician's age, size of practice and computer knowledge. Pearson's Chi Square was used to evaluate differences across populations at a significance level of 0.05. Our sample size was relatively small therefore; he collapsed the age variable into three categories (20-40, 41-50 and 50+), practice size variable into three categories (solo, 2-30, and 30+), and the computer knowledge variable into three categories (novice-slight, average, and high-expert). Contrary to popular belief, there was no significant difference found in use across age groups (Chismar, 2002). Some researchers contend that older

physicians are less likely to use computers and information technology. Most applications did have a higher use by younger physicians, however the use of the Internet to access palm computer applications was 12.5% for respondents in the 20-40 age group and 24.2% for respondents in the 50 years and older age group.

Chismar found however, three significant differences in use of the sixteen Internet-based health applications across practice size: the use of electronic medical records, transmission of claims data and purchasing of supplies. Figure 5.1 shows the percentage of respondents in each practice size category that reported using each of the three applications. The results indicate that despite only three significant differences out to the 16 applications, there was a very clear trend of greater use among larger practices. In fourteen of the 16 applications, respondents from larger practices reported greater use than those in smaller practices; with the exception transmission of claims data and purchasing of supplies.

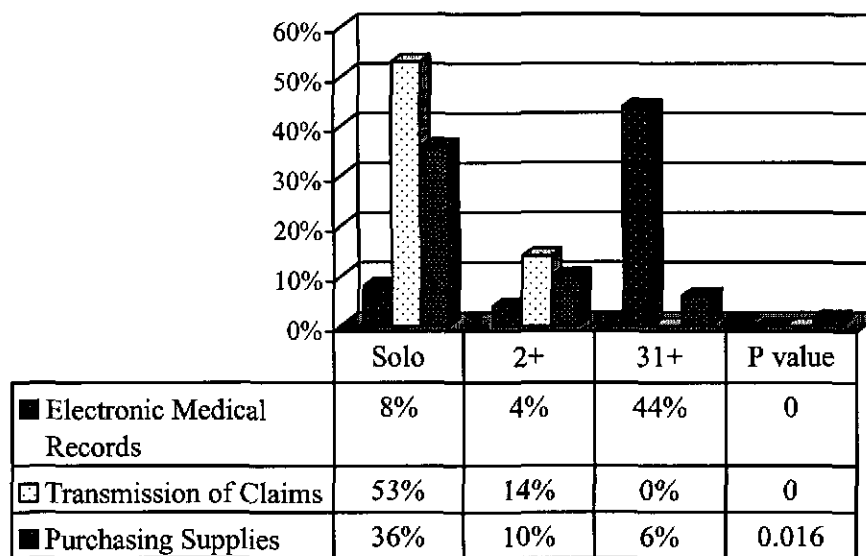


Figure 5.1 Differences in Use across Practice Size

As we expected, a higher knowledge of computers is associated with higher use across all applications; the only exceptions were use of electronic medical records and transmission of claims data. Of the 16 Internet-based applications, there were five significant differences found across levels of computer knowledge (use of the Internet to search medical literature, access professional news, access drug information, transmit non-claim administrative data, and access palm computer applications). Figure 5.2 shows the percentage of respondents in each knowledge level using each of the five IHAs, along with the p value of the Chi Square test.

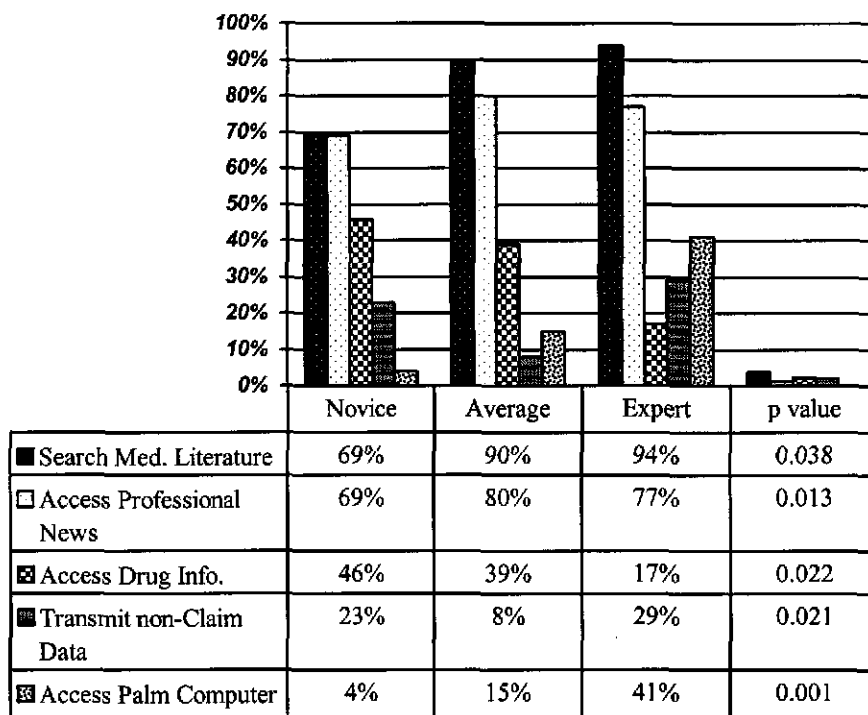


Figure 5.2 Differences in Use across Computer Knowledge

In addition to analyzing the demographic differences across the IHAs individually, the applications were rank ordered by level of use for each of the three demographic variables. The Kendall's W test was used to evaluate differences across the rankings. The data indicated that no significant differences was found by relative level of use with age group, size of practices or level of computer knowledge. Chismar's findings imply that while pediatricians may use individual applications at different rates, the applications they use most frequently and least are often similar (2002).

Our combined results provide evidence contrary to some beliefs about physicians' use of information technology.

1. Age was not a significant determinate of Internet use. There was not a stronger tendency for higher use of IHAs by younger pediatricians as one might assume.
2. While larger practices do use the Internet more, smaller practices are not significantly different in their use. Solo practices are quick to adopt applications with clear financial benefits. Over half of the solo practices in our study used the Internet to process claims; none of the larger practices with thirty physicians did so. Also over one-third of the solo practices used the Internet to purchase supplies, versus only six percent of the largest practices.
3. While physicians with higher computer knowledge did tend to use more applications, the trend was not strong. Consequently, there is no significant difference between novice use of the Internet and more knowledgeable user across most of the Internet-based health applications (Chismar, 2002).

5.5 Measurement Scale Test-Retest Reliability Results

In order to address the remaining research questions we must provide the reliability results of the measurement scale. As mentioned in chapter 4 we used Cronbach's alpha coefficients test to obtain the subscale reliabilities of the modified TAM2 constructs. According to Nunnally (1978), .70 is an acceptable level for an initial research effort. Our pretest measurement instrument ranged from .72 to .92. Table 5.8 demonstrates the internal consistency of the pretest subscale measures. As a process of our data manipulations, we dropped two items from the result demonstrability construct. Those items were questions (1): *IHA could reduce the cost of my care delivery* and question (25): *I would have difficulty explaining why using IHA may or may not be beneficial*. Although the items tested fine in the field test, their inclusion in the reliability analysis decreased the internal consistency of the Result Demonstrability construct. The Cronbach's alpha = .52, with all four items and increased to .72 when excluding questions 1 and 25.

Table 5.8. Analysis of Pretest Measurement Reliability (N=89)

Construct	No. Items	Mean	Std. Dev	Cronbach's Alpha
Perceived Usefulness	4	3.7	2.8	.86
Perceived Ease of Use	4	3.2	3.0	.85
Intention to Use	2	4.0	1.5	.83
Subjective Norm	2	3.1	1.5	.86
Image	3	2.6	2.5	.92
Job Relevance	2	3.4	1.5	.75
Output Quality	4	3.2	3.1	.86
Result Demonstrability	2	3.4	1.4	.72

This pattern of high reliability is consistent with prior research (Wright &

Granger, 2001; Venkatesh & Davis, 2000; Davis & Venkatesh, 1996; Taylor & Todd, 1995; Davis, 1989). Moreover, the high values of alphas assured the researcher that the items associated to the factors coalesced together adequately to continue measuring the factors in relationship to pediatricians' intentions toward IHA. We deduce that the modifications made to the TAM2 constructs were necessary and appropriate for measuring pediatrician's intentions. The field-testing procedure using physicians as our focus group proved beneficial.

Consistency across time is an indicator of reliability because we assume that the traits that we want to measure are relatively stable across time; therefore measures that *have a high degree of true score should also be stable across time*. Consequently, one way of assessing reliability is referred to as test-retest reliability, is to assess people's scores on a measure on one occasion, assess the same people's scores on the same measure on a later occasion, and compute the correlation coefficient for the two assessments; that correlation coefficient represents the degree of reliability shown by the measure. Whitley (1996) states that the concept of reliability does not require that the people's score be exactly the same on both occasions; random error makes this outcome unlikely. All that is required is that people's scores fall in generally the same rank order: that physicians who score high the first time also score high the second time.

In order to conduct the test-retest analysis, we computed the scores of the 52 subjects who completed both, the initial or pre-survey and the second or post-survey. The alpha coefficients for the test-retest are presented in Table 5.9. Our results are consistent with the reported Cronbach's alpha coefficients reported in previous research.

Davis (1989) reported alpha coefficients of .98 for perceived usefulness and .94 for perceived ease of use subscales. Hendrickson, Massey and Cronan (1993) reported the smallest alpha coefficient found was .89, while the largest was .96. Based on their results, the original TAM scale was considered reliable.

Our Cronbach's alpha coefficients range from .30 as the smallest to .94 as the largest. The original TAM subscales (PU, PEOU and ITU) were relatively sound, however the result demonstrability subscale performed poorly across both (T1-T2).

The overall instrument is reliable, with the exception of result demonstrability and the perceived ease of use retest coefficients. Both fall well below the acceptable Cronbach's alpha coefficient, .30 and .60 respectively. Wrightman (1991) suggest a minimum internal consistency coefficient of .70 and a minimum test-retest correlation of .50 across at least a three-month period. Our initial instrument (T1) was administered by mail in March 31, 2001. The second instrument (T2) was administered by in June 15, 2001. Our test-retest time period (March-May) fits well within the timeframe discussed by Wrightman (1991).

Our results are consistent however with previous research that evaluated the original TAM constructs (Hendrickson et al., 1993; Galletta & Lederer; Torkzadeh & Doll). Two of the perceived usefulness individual item correlation results were exceptionally low. The individual items measuring "increased productivity" (-.027) and "improve quality of care" (-.012) both had test mean scores bordering the neutral to agreement categories (on a scale 1-5, with 3 representing neutral to 4 representing agree). However, the subscale correlations were very high (see Table 5.10). Hendrickson et al

(1993) reported even lower test-retest individual items mean scores for both perceived usefulness and perceived ease of use for their spreadsheet application study. However their subscales' correlations were all above .80, the acceptable correlation level, that suggests that an instrument is reliable (Nunnally, 1978).

Table 5.9. Test-Retest Reliability: Cronbach's Alpha (N = 52)

TAM2 Subscales	Test	Retest
	T1	T2
Intention	.80	.70
Perceived Usefulness	.81	.90
Perceived Ease of Use	.80	.60
Subjective Norm	.94	.90
Image	.92	.70
Job Relevance	.75	.81
Output Quality	.85	.80
Result Demonstrability	.42	.30

As shown in Table 5.9 the *Result Demonstrability* scores are consistently low across all reliability tests. These low level alphas could be a reflection upon the small size or the subject's comprehension of the particular test items. A second and more plausible explanation is that of relativity and equivocality of the result demonstrability construct. The questions or items measuring the result demonstrability construct maybe ambiguous in general or irrelevant to this sample of physicians.

With the exception of result demonstrability and taking into consideration the overall alpha coefficients, the high mean scores, no significant mean difference for items and the consistency of our results with previous research, our results indicate the test-retest reliability of the TAM2 (2000) instrument.

Table 5.10. Test-Retest Statistics

	Test Mean T1	Retest Mean T2	Correlation (T1-T2)*	Significance Of t-value
Intention to Use				
Intend to Use	3.98	3.98	.122	.393
Predict Using	4.07	3.94	-.155	.278
Subscale Total	4.0294	3.9608	.046	.749
Usefulness				
Increase Productivity	3.70	3.66	-.027	.850
Improve Quality of Care	3.60	3.72	-.012	.934
Enhance Effectiveness	3.70	3.68	-.080	.576
Useful in Job	3.74	3.82	-.162	.257
Subscale Total	3.6627	3.7308	-.102	.474
Ease of Use				
Clear and Understandable	3.62	3.84	-.066	.650
Easy to Use	3.05	3.21	-.075	.602
Little Mental Effort	2.76	3.68	.196	.387
Easy to Manipulate	2.46	2.75	.126	.163
Subscale Total	2.9854	3.1440	.200	.155
Subjective Norm				
Other's Influence on Me	3.04	3.00	-.100	.493
Other's Importance to Me	2.93	2.81	.015	.916
Subscale Total	2.9898	2.9082	-.057	.699
Image				
Status Symbol	2.62	2.82	-.025	.862
Prestige	2.54	2.70	-.021	.884
High Profile	2.66	2.84	-.241	.088
Subscale Total	2.6139	2.7155	-.192	.178
Job Relevance				
Usage Relevant to Job	3.48	3.69	.141	.317
Usage Important to Job	3.27	3.33	-.041	.777
Subscale Total	3.3824	3.5098	.047	.744
Output Quality				
Consumer Info. High	2.76	3.01	.212	.131
Pediatric Info. High	2.96	3.21	.252	.071
Professional Info. High	3.29	3.56	.072	.618
Expect Future Info. High	3.61	3.75	.180	.202
Subscale Total	3.1520	3.3578	.293	.037*
Result Demonstrability				
Reduce Cost of Care	3.16	3.14	-.051	.729
Communicate Consequences	3.32	3.52	-.216	.133
Apparent Results	3.43	3.54	.111	.437
Explaining Benefits of Usage	3.29	3.31	.009	.951
Subscale Total	3.1600	3.1716	.115	.423

Our data suggests that result demonstrability is not a good fit with physicians. The essence of the construct, which measures “perceived tangibility” of results, may not be a factor that is important to physicians. We will further discuss these findings in chapter 6.

The results of the paired t-tests of the subjects’ mean responses and correlation coefficients between individual scale items for the initial test and retest are shown in Table 5.10. There are no significant differences for individual items. There is one significant difference found at the 0.05 level between the subscale means of *Output Quality* and there are two subscales (*Intention to Use* and *Job Relevance*) with correlations less than .50. Although the result demonstrability Cronbach’s alpha coefficients were very low, all other constructs showed high reliability, the majority of the subscale correlations were high and there was no significant difference between individual items. As previously mentioned our study indicates the test-retest reliability of the research instrument.

5.5.1 Construct validity analysis

To validate the TAM2 instrument Venkatesh and Davis (2000) used principal component analysis (PCA) with direct oblimin rotation. When we applied the same method only four component were extracted. Therefore, to test for construct validity for this study exploratory factor analysis (EFA) was performed on the survey items with SPSS version 11.0 using maximum likelihood extraction, with promax oblique. The

promax rotation methods are chosen here because the independent variables are not assumed to be completely orthogonal or (unrelated).

The values of the eigenvalues and the percentage of variance indicate that the first five factors explain a large percentage of the variance (Table 5.11.). An eigenvalue is the proportion of variance explained by each factor. The criterion used here is the percentage of variance. This criterion requires interpretation of the cumulative percentage of variance accounted for by the factor solution. The percent of variance explained by each factor is the eigenvalue divided by the sum of the communalities (23 in this case) because the 2 items for the result demonstrability construct were dropped. George and Mallery (2001) recommend omitting variables, which load strangely, (highly on different factors) and running the factor analysis again to determine if the results differ.

In reference to the findings of the variance percentage, the factors explaining a small percentage of the variance are deemed to be of little practical significance. In the Social Sciences, it is common to consider a satisfactory solution as one that accounts for 60% of the total variance. The five components extracted in this study account for 75% of the total variance

The Kaiser-Mayer-Olkin (KMO) and Bartlett's tests were conducted to determine if our distribution of values is adequate for conducting factor analysis. Kaiser himself designates levels as follows: A measure .9 is marvelous, .8 is meritorious, .7 middling, .6 is mediocre, .5 is miserable, and .5 is unacceptable. In our case, .867 is meritorious, see figure 5.3.

The Bartlett's test of sphericity is a measure of the multivariate normality of our set of distributions. It also tests whether the correlation matrix is an identity matrix (factor analysis would be meaningless with an identity matrix). A significance value $< .05$, as is with our results, indicates that these data do NOT produce an identity matrix and are thus approximately multivariate normal and acceptable for factor analysis.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.867
Bartlett's Test of Sphericity	
Approx. Chi-Square	1418.124
df	253
Sig.	.000

Figure 5.3 KMO and Bartlett's Test

Table 5.11, indicates that the first component accounts for nearly 44% of the total variance inherent in the data.

Table 5.11. Eigenvalues and percentages of variance for the extraction of component factors (Total Variance Explained)

Component		Initial Eigenvalues	% of Variance	Cumulative %	Rotation Sums of Squared Loadings
		Total			Total
1		10.067	43.768	43.768	8.319
2		2.503	10.883	54.651	7.014
3		2.067	8.985	65.636	4.974
4		1.558	6.774	70.409	5.114
5		1.001	4.350	74.760	4.066

As previously stated, five factors were extracted from this study. The results above show the first five factors for accounting for 75% of the total variance. The eigenvalues for the first five factors were greater than or equal to 1. This led us to

conclude that the five factors could be used to summarize pediatricians' intentions toward adoption in this study. Based on literature and the knowledge of a statistical advisor, we conducted an oblique rotation procedure using the promax application in SPSS, which is aimed at simplifying the Factor Pattern Matrix, while allowing for correlations among the factors. The rotation converged in 6 iterations. The results are shown in Table 5.12.

Examining the factor loadings in Table 5.12, we see that the variables for *perceived usefulness*, *intention to use*, and *job relevance* all loaded highly on the first component, each loading above .5, with the exception of item 2 for job relevance.

Table 5.12. Component Structure Matrix

	1	2	3	4	5
PU1	.833				
PU2	.749				
PU3	.917				
PU4	.775				
ITU1	.728				
ITU2	.929				
JR1	.574				
JR2	.459	.461*			
IMG1			.838		
IMG2			1.01		
IMG3			.876		
SN1					.693
SN2					.950
OPQ1				.798	
OPQ2				.987	
OPQ3				.641	
OPQ4				.519	
PEOU1	.494*	.404			
PEOU2		.756			
PEOU3		.896			
PEOU4		.890			
RD1		.589			
RD2		.300			

* Note that these items had cross loading on 2 factors

Similarly, for the second component, the variables for *perceived ease of use* and *result demonstrability* loaded together. However, the PEOU1 item also cross loaded onto component 1 at .49 and the RD2 item loaded at less than .5. The third, fourth and fifth components were more in line with previous literature, with the variables for *image* all loading on component 3 and exhibiting factor loadings above .83. The *Output quality* variables all loaded highly on component 4 ranging from .51 to .98. The variables for subjective norm exhibited high loadings on component 5.

Kachaigan (1991) states that if a variable loads high on one factor, we do not want it to also load high or even moderately high, on another factor; otherwise it would be difficult to distinguish between the factors with respect to that variable. Because the factors for this research were chosen a priori, (based on the TAM theory, logic, fixed rules or forms, instead of experience or experiment) we can distinguish between the factor and the variables. Understanding the composition of the TAM2 theory it is not difficult to see why job relevance and intention to use loaded on the perceived usefulness construct. Result demonstrability, which is the tangibility of the results of using a technology loaded on the perceived ease of use construct. Notice also that two variables - job relevance (2) and perceived ease of use (1) are listed on factors 1 and 2 due to their moderate loadings on both. Again, because the constructs were chosen a priori we applied them according to the literature.

5.6 Pre-test Regression Analysis

Multiple regression analyses were performed using SPSS version 11.0. The dependent variables for this study are **perceived usefulness** and **intention to adopt IHA**.

The independent variables are *perceived ease of use, subjective norm, image, job relevance, and output quality and result demonstrability*. Regressions were run for each dependent variable for the full pretest sample. Multiple regressions were also run for the full posttest sample as well as the subset sample that completed both the pre and posttest, however these results are reported in section 5.7.

Stepwise regression analysis was performed to explain intention to use. Table 5.13 shows the effect of perceived usefulness and output quality on intentions.

Table 5.13. TAM2 Pretest Regression Results Explaining Intention to Use

R	R ²	Adj R ²	Perceived Usefulness			Output Quality		
			Beta	t	Sig.	Beta	t	Sig.
.773	.598	.588	.660	8.460	.000	.211	2.707	.008

*p < .05, Adjusted R²= .59, Beta = standardized regression coefficients

Consistent with prior research, perceived usefulness was a strong determinant of intention to use, and output quality was a significant secondary determinant; however perceived ease of use, subjective norms, image, job relevance and result demonstrability were statistically excluded from the model by the stepwise regression method, which removes the “weakened” variables. TAM2 thus explained 59% of the variance in adoption intentions. This finding is consistent with prior research as, Venkatesh and Davis (2000) reported that TAM2 explained between 37% and 52 % of the variance in usage intention. To explain usefulness we performed a stepwise regression analysis with usefulness as the dependent variable and all other variables except intention as possible

predictors. One predictor was retained, job relevance ($R=.77$, $R^2 = .60$, $\beta = .775$, $t = 11.035$, $p < .000$).

Table 5.14 shows, that TAM2 explained up to 60% of the variance in perceived usefulness. This is a much greater percentage that has been explained in previous literature. The standardized beta coefficients indicated that job relevance was weighted the most, followed by intention to use and result demonstrability.

Table 5.14. TAM2 Pretest Regression Results Explaining Perceived Usefulness

R	R ²	Adj R ²	Job Relevance		
.775	.601	.596	Beta	t	Sig.
			.775	11.0	.000

* $p < .05$, Adjusted R² .59, Beta = standardized regression coefficients

5.7 Analysis for Research Questions 2

Research Question 2: *Can educational interventions affect physicians' intentions to adopt Internet-based health applications?*

To address this question, the following procedures and analysis were performed. The modified TAM2 instrument was mailed to 200 pediatricians, excluding five discrepancies from our original list. The survey followed an educational intervention, which introduced the physicians to the clinical advantages of using a personal digital assistant. We decided to mail the posttest to all 200 of the practicing pediatricians on the HAAP mailing list regardless of their response to the initial (pre-test) survey. We did this because of our small sample size. Our hope was to capture as much data as possible from pediatricians in Hawaii. Seventy-eight surveys were returned and 75 were deemed usable, yielding a posttest response rate of 38%. According to Weisberg, Krosnick and

Bowen (1995) response rates for mail questionnaires tend to be between 10% and 50%. Pooling our pretest and posttest responses this study yielded an overall response rate of 82%.

In addition to completing the 25 item 5-point TAM2 likertscale, the posttest survey asked pediatricians to indicate whether they had attended the research sponsored seminar or if they had attended any other workshop or seminar concerning the Internet and Internet-based health applications, within the past six months. Our data analysis revealed 52 subjects had completed both the pretest and posttests, which accounted for 45% of the posttest sample size. Twenty-three of the respondents had only completed the study's posttest, therefore we gained information from an additional 12% of the local pediatrician population, which justified mailing the extra surveys.

However, we discovered that only 8 of the (N=52) respondents had attended the research sponsored workshop, 11 of the 52 indicated that they attended a different workshop and 33 reported that they did not attend any workshop regarding the Internet or Internet-based health applications in the past six months.

Table 5.15 shows the attendance of the pediatricians to the research treatment or other treatments.

Table 5.15. Pediatricians Attendance and Treatment Type

	Frequency	Percent	Valid %	Cumulative %
Research Treatment	8	15.4	15.4	15.4
Different Workshop	11	21.2	21.2	36.5
No Treatment	33	63.5	63.5	100.0
Total	52	100.0	100.0	

As discussed in chapter four, the subjects were invited to attend an Internet-based health applications seminar as a part of the routinely scheduled 'grand rounds' at a local hospital. Although, over forty pediatricians attended, we were unable to capture all of their posttest data because we did not administer the TAM2 questionnaire immediately following the seminar. Instead, we mailed questionnaires to all of the target subjects (N=200) after the seminar. For this reason our treatment numbers are extremely small and findings regarding the difference the treatment may or may not have had on pediatricians' intention to adopt should be interpreted with that knowledge in mind. Using paired-samples t-test to analyze the data, the following findings are reported for only those pediatricians who completed both the pretest and posttest (N=52). As Table 5.15 indicates, 8 of the respondents attended the research-sponsored treatment, 11 reported attending a different treatment and 33 reported attending no treatment within the last six months. Table 5.16 shows that group mean levels for perceived usefulness and intention to use did not change. Using a two-tailed test for mean difference, the research seminar did show a very small difference in two variables, *output quality* ($t[7] = -2.25$, $p < .059$) and *perceived ease of use* at ($t[7] = -2.56$, $p < .037$).

This means that pediatricians perception of output quality after the treatment was different from what it was before the treatment. The mean difference score for output quality was $-.6875$, which is $.6875$ points below the mean of zero on the distribution of means. In other words, on the average, pediatricians' perception of output quality decreased by $.6875$ points, after attending the research seminar. The same is evident of pediatricians' perception of ease of use. The perceived ease of use mean of difference

scores -0.5938 is -2.56 standard deviations below the mean of the distribution of means. This suggests that pediatricians perceived ease of use is different after the treatment. This evidence along with no significant changes in the group mean scores for either treatments or the control group for the main variable “intention to use”, gives us an inconclusive answer for the research question, yet causes us to find no support for proposition 7.

Proposition 7: Intention to use measures taken after the educational intervention will differ significantly from those taken prior to, the intervention.

Follow up discussion with several physicians who did participate in the educational intervention volunteered suggestions for the enhancement of future IT and healthcare interventions. Those recommendations included:

1. Providing a technology that physicians could actually interact with and leave the workshop with a sense of some hands-on experience.
2. Providing a speaker from within the local culture of the physicians involved in the study. Physicians exist within specific cultures or cliques according to their type and size of practice, specialty and local. Our speaker was a prominent pediatrician from Yale University, while he has influence within the field of medical informatics and pediatric care, local physicians may relate better to opinion leader amongst their own.
3. Provide the instrument on-line as well as in paper format. This would give physicians a choice, and they could complete the survey, which best meets, the personal preferences.

Table 5.16. T-Test For Pediatricians Attending Research-Sponsored Treatment

		Mean	N	Std. Dev.	Std. Error Mean	Paired Samples Test	t	df	Sig. (2-tailed)
Pair 1	Subjective norm	2.6875	8	.8839	.3125	Subjective norm-Post subjective norm	-.683	7	.516
	Post Subjective Norm	2.9375	8	.8634	.3053				
Pair 2	Image	2.3750	8	1.0752	.3802	Image - Post Image	-.311	7	.765
	Post Image	2.5400	8	.9073	.3208				
Pair 3	Job Relevance	3.3750	8	.8763	.3098	Job relevance – Post Job relevance	-.760	7	.472
	Post Job Relevance	3.6875	8	.8425	.2979				
Pair 4	Output Quality	2.8438	8	.7899	.2793	Output quality- Post Output quality	-2.252	7	.059*
	Post Output Quality	3.5313	8	.7126	.2519				
Pair 5	Results Demonstrability	2.8750	8	.5669	.2004	Results demonstrability-Post Results demonstrability	-.753	7	.476
	Post Results Demonstrability	3.0625	8	.5132	.1815				
Pair 6	Perceived Usefulness	3.6750	8	.9130	.3228	Perceived Usefulness- Post Usefulness	-.165	7	.874
	Post Perceived Usefulness	3.7500	8	.8238	.2912				
Pair 7	Perceived Ease of Use	2.4063	8	.5165	.1826	Perceived Ease of Use – Post Ease of Use	-2.569	7	.037*
	Post Perceived Ease of Use	3.0000	8	.3780	.1336				
Pair 8	Intention to Use	3.6875	8	.9978	.3528	Intention to Use – Post Intention to Use	-.649	7	.537
	Post Intention to Use	4.0000	8	1.0351	.3660				

5.8 Posttest Regression Analysis

To evaluate the effect of the intervention on adoption intentions, we performed a regression analysis using the full posttest sample of (N=75), which we also compared to adoption intention results of the pre-test regression model. It should be noted that these groups do compare differently as only 52 subjects were in common. Table 5.17. provides the results of the posttest regression analysis

Table 5.17. Posttest TAM2 Regression Explaining Intention to Use

R	R ²	Adj R ²	Perceived Usefulness			Subjective Norm			Job Relevance		
			Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
.808	.653	.639	.455	3.795	.000	.216	2.859	.006	.284	2.314	.024

*p < .05, Adjusted R²= .64, Beta = standardized regression coefficients

Based on our analysis, TAM2 explained 64% of the variance in intention to use, similar to the pretest results, which explained nearly 60% of the variance. Consistent with the pretest and previous research perceived usefulness was again a strong determinant factor. Next, we conducted a regression with intention as the dependent variable using only the 52 subjects that completed both the pretest and posttest. The results are shown in Table 5.18.

Table 5.18. Posttest (subset N=52) TAM2 Regression Explaining Intention to Use

R	R ²	Adj R ²	Perceived Usefulness			Subjective Norm			Job Relevance		
			Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
.814	.663	.642	.453	3.159	.003	.244	2.725	.009	.299	2.063	.045

*p < .05, Adjusted R²= .64, Beta = standardized regression coefficients

Again, TAM2 explained a considerable percentage of the variance in intention to adopt at 64%, as perceived usefulness was still consistent with the full posttest sample set. These findings are also consistent with this study's pretest sample and prior research. As theorized perceived usefulness is the stronger determinant of intention to use IHA. The normative construct, subjective norm and job relevance had significant positive effects on intention across both posttest sample sets. However, perceived ease of use was not an influential predictor of intention for either the pretest or posttest. This finding contrasts that of Wright et al. (2001), Venkatesh and Davis (2000), Taylor and Todd (1995) and Adams et al. (1992).

To examine perceived usefulness, we performed stepwise regression analysis first with the all (75) subjects posttest subjects and secondly, with the subset of (52). As with the pretest analysis of perceived usefulness, the construct intention to use was not estimated in this regression model. The results are reported in (Table 5.19 and Table 5.20) respectively.

Table 5.19. Posttest Regression Perceived Usefulness

Posttest (N=75)				R	R Square	Adjusted R Square	Std. Error of the Estimate
				.878	.771	.762	.3653
	Standardized Coefficients	t	Sig.				
	Beta						
(Constant)		.780	.438				
Post Job Relevance	.649	7.79	.000				
Post Results Demonstrability	.439	5.744	.000				
Post Output Quality	-.186	-2.532	.017				

*p < .05, Adjusted R²= .76, Beta = standardized regression coefficients

Table 5.20. Posttest (subset) Regression Perceived Usefulness

Posttest (N=52)				R	R Square	Adjusted R Square	Std. Error of the Estimate
				.859	.737	.721	.36562
	Standardized Coefficients	t	Sig.				
	Beta						
(Constant)		1.669	.102				
Post Job Relevance	.743	6.999	.000				
Post Results Demonstrability	.375	3.993	.000				
Output Quality	-.221	-2.146	.037				

*p < .05, Adjusted R²= .72, Beta = standardized regression coefficients

TAM2 explained more than 70% of the variance in perceived usefulness in the posttest analysis for both the full post sample set and the subset. The effects of job relevance, result demonstrability and output quality were significant across both posttest sample sets.

5.9 Analysis of Research Question 3

As previously mentioned our aim here was to determine if the TAM2 theory is applicable in the context of healthcare, specifically within physicians. To answer this question we must first look at the descriptive statistics of the responses to the intention to use items from the TAM2 survey and secondly perform regression analyses on the TAM2

Using descriptive statistics on the Intention to Use variables, (questions 3 and 9) of the survey, we obtained the response percentages for both the pretest and posttest respondents. The results state that 78% of the pre-test respondents intend to use IHA, if

significant barriers did not exist. Identically, 78% of the posttest respondents intend to use IHA, again if significant barriers did not exist.

The posttest analysis results presented in the following section will show that overall, TAM2 is applicable, but to the degree of applicability is limited. As it is with any theory, there is always room for improvement and a need for context specification, which is discussed in the next chapter.

Note that in the following pretest findings neither, subjective norm [internalization] or image [identification] had an effect on perceived usefulness, or intention, which is inconsistent with theory. However, in the posttest analysis subjective norm was significant in explaining intention for both samples of the posttest, which gives us mixed support for our first proposition:

Proposition 1: Subjective norms will have positive effect usefulness.

Image, interesting enough had no effect on perceived usefulness for either the pretest or posttest. Thus rejecting the second proposition:

Proposition 2: Image will have a positive effect on perceived usefulness.

As theorized in the literature the cognitive instrumental processes (output quality, job relevance and result demonstrability) were significant in explaining usefulness in the posttest analysis.

Proposition 3: Job relevance will have a positive effect on perceived usefulness.

Proposition 4: Output quality will have a positive effect on perceived usefulness.

Proposition 5: Result demonstrability will have a positive effect on perceived usefulness.

Consistent with theory, job relevance and result demonstrability were influential for pediatricians' perception of usefulness for across both samples of the posttest analysis, supporting propositions 3, 4, and 5

Our regression results show that perceived ease of use was not a significant influence on either, perceived usefulness or intention to adopt. Hence, proposition 6 was not supported. This finding is quite inconsistent with previous literature, as ease of use is one of the original and main theoretical constructs of TAM, however this discovery may well be an artifact of our sample and context. Venkatesh et al. (2000, p.198) reported a systemically lower stability correlation for ease of use across their four studies and three time periods. Ease of use has been found by other studies to have no significant effect on perceived usefulness (Hu et al., 1999), specifically where physicians are concerned.

Proposition 6: Perceived ease of use will have a positive effect on perceived usefulness.

The ability of TAM2 to explain pediatricians' intentions to use/adopt IHA was examined using multiple regression analyses, which is appropriate for testing developed underlying theory. Figure 5.3 provides a summary presentation of the combined results for our modified TAM2 with the pretest and posttest respondents.

In agreement with TAM2 postulations, perceived usefulness was found to have a significant and strong influence on physicians' intention to use Internet-based health application. Job relevance and output quality were influential secondary determinants, however perceived ease of use was not significant and contrary to what TAM2

hypothesized. One explanation may lie in the context that pediatricians are characteristically different from the usual test bed of subjects for TAM.

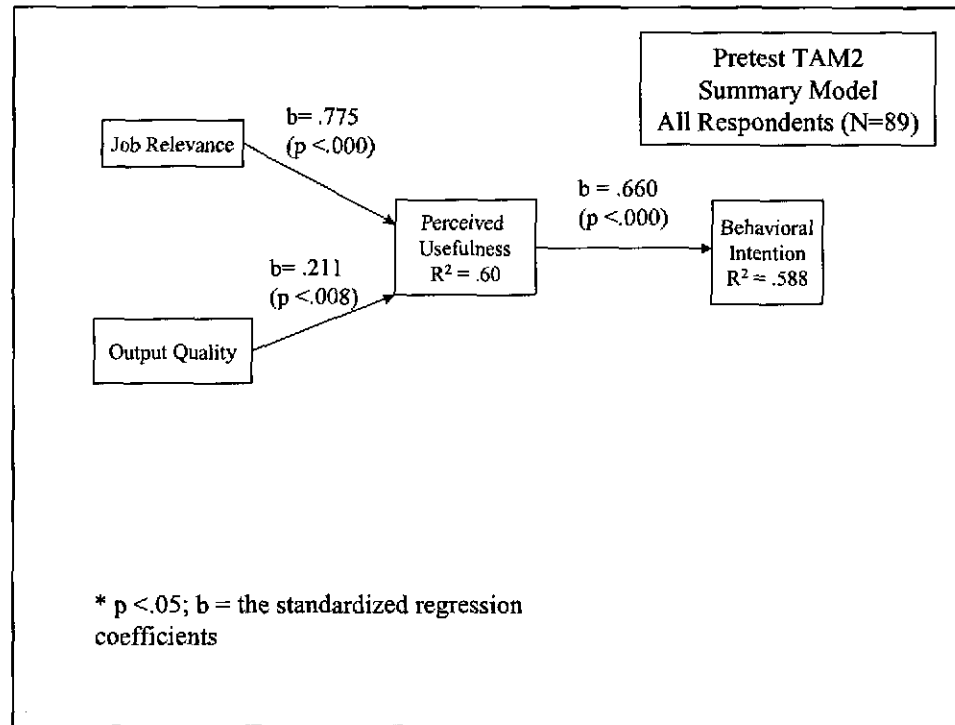


Figure 5.4. TAM2 Summary of Results for Pretest

Perceived ease of use, or “use without effort” seemingly did not apply to pediatricians, who appear to be more practical, in the sense that they are better skilled, sophisticatedly trained and experience with various medical-related technologies. Pediatricians concerns were with the usefulness of the technology. These findings are similar to those of (Hu et al., 1999).

A second explanation for the lack of perceived ease of use is that the subjects did not have an actual technology in which they could have experience in using or testing. Prior TAM studies often test a technology, which is new or newly implemented into an

organization. For this reason, we cannot assert that pediatricians would not measure differently on perceived ease of use if they were given access to an IHA.

Figure 5.5 and Figure 5.6 present the summary of our post analysis results with both sample sets. Again consistent with theory, perceived usefulness was the dominant variable in explaining pediatricians' intentions to adopt IHA. However, the post analysis subjective norm and image were found influential determinants in predicting pediatricians' intention to use Internet-based health applications. The social influence processes after the research intervention were consistent with TAM2. Subjective norm significantly influenced perceived usefulness via internalization, in which people incorporate social influences into their own usefulness perceptions, and image influence perceived usefulness via identification, in which people use a system to gain status and influence within the work group and thereby improve their job performance (Venkatesh et al., 2000, p. 198).

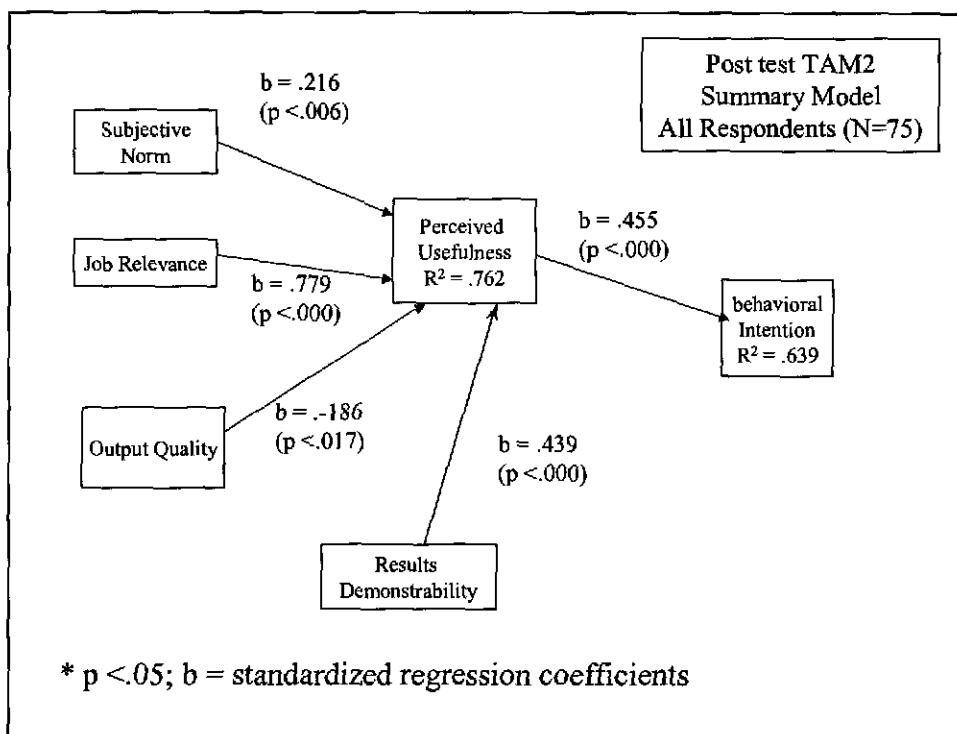


Figure 5.5. Summary of Results for Posttest with all 75 Respondents

The effects of the cognitive instrumental processes were also consistent with TAM2. An interesting finding that emerged was the results compared between the posttest samples regarding the cognitive processes. Both, job relevance and result demonstrability were significant and consistent with TAM2 across the two samples. As previously mentioned, perceived ease of use was not significant for the posttest results.

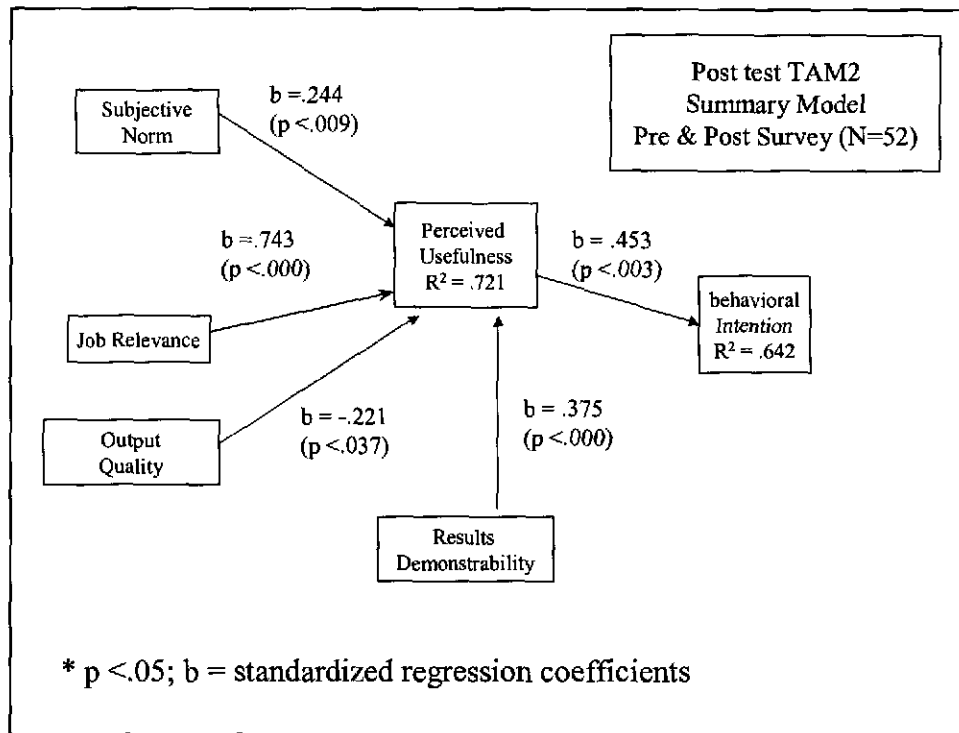


Figure 5.6. Summary of Results for Posttest with Subset Respondents

5.10 Exploratory Analysis

Although we did not formulate specific research questions to address various contextual issues we did further analyze data using stepwise multiple regression analyses to determine if such factors as institutional (primary practice), age group and technology use would enhance the research model or if they would have any influence on physicians intentions to adopt IHA.

In order to examine these factors we recoded the primary practice items as dummy variables (e.g. solo private practice = 1, HMO = 0, etc) and included the factors as independent variables along with the existing TAM2 constructs in our multiple regression model. We use intention to use as our dependent variable in the analysis.

Using the adjusted R square our results show that the model explained 56% of the variance for intention to use when the institutional construct was included, however the variable was not significant at the .05 level ($R=.77$, $R^2 = .60$, $\beta = .025$, $t = .317$, $p = .752$). This indicates that the type of primary practice does not influence our subjects' intention to adopt IHAs. This is consistent with our cross tabulation analysis results, which indicates that the size of practice is not a significant factor for pediatricians' use of the Internet-based health applications. As a result of our analysis perceived usefulness was however the determining influence in this model ($R=.77$, $R^2 = .60$, $\beta = .575$, $t = 4.377$, $p = .000$).

Sobol, Alverson and Lei (1999) report that age is a possible barrier to physicians intention to adopt information technology. We recoded our age group variables into dummy variables as we did with the institutional construct and then ran a stepwise regression analysis with intention to use as the dependent variable and age group as an independent variable along with the existing TAM2 constructs. TAM2 explained 53% of the variance in adoption intentions, perceived usefulness ($R=.76$, $R^2 = .53$, $\beta = .469$, $t = 3.227$, $p = .003$) emerged again as the dominant factor. Age was not a significant influence on physicians' intention to adopt ($R=.76$, $R^2 = .53$, $\beta = -.077$, $t = -.961$, $p = .340$). This result was also consistent with the cross tabulation results across application use. Our results indicate that pediatricians as a group are not techno phobic and age is not a significant influence in predicting intentions' to adopt.

Our last exploratory analysis was conducted using the composite or average scores on questions 1 and 2 of the initial survey (T1). We asked the pediatricians to

indicate the degree of computer and Internet use on a scale of 1-5, (1 = never, to 5 = everyday) for various IHAs. Using the respondents' composite scores we generated *computer use* and *Internet use* variables. Again, we included these factors as independent variables along with the existing TAM2 constructs in our research model and performed stepwise regression using Intention to Use as the dependent variable.

Reporting the adjusted R square our results indicate that TAM2 explained 59% of the variance in Intention to Use. As expected perceived usefulness remained the determining influence for adoption intention ($R=.77$, $R^2 = .59$, $\beta = .660$, $t = 8.460$, $p = .000$). Interestingly, output quality, which is the measure of how well a system performs the task, at hand also emerged significant at the 0.05 level ($R=.77$, $R^2 = .59$, $\beta = .211$, $t = 2.707$, $p = .008$). While neither computer use nor Internet use was significant at the 0.05 level in the regression analysis their inclusion did enhance the model's overall fit. Current use of the computer and Internet may have an influence on pediatricians' adoption intention toward Internet-based health applications.

Throughout this study, perceived usefulness has remained the determining factor for physicians' intention to adopt IHA. The strong perceived usefulness influence is consistent with prior research (Hu et. al., 1999 & Chau & Hu, 2002) that suggest that physicians in general are more practical than the average subjects that are commonly used in TAM research.

Davis (1989) has suggested that assessments of ease of use and usefulness are essential determinants of the use of information technology. Todd and Benbasat (1999) note that at the core of the usefulness concept is the idea that the decision-maker

(physician) will improve their performance (provide better quality care and reduce cost). The authors note that the assessment of usefulness is partly determined by perceptions of ease of use. Interestingly enough, ease of use was not a significant influence for pediatricians' decision or intention to adopt. Perhaps, because there was not an actual system in place for the physicians to use, which would have provided them the necessary information to help formulate a decision on whether a particular Internet-based health application would allow them to work smarter, rather than harder (Todd & Benbasat, 1999). These results have led us to undertake a future study that will examine the perceived effort-perceived accuracy perspective presented in the Todd & Benbasat, (1999) research.

In consideration of our small sample size and the exploratory study approach, overall TAM2 was reliable and adequate in predicting pediatricians' adoption intentions. As with any theoretical concept there is always a need for enhancement and further investigation. This is the case with TAM2 and the question of its complete applicability in the healthcare arena, particularly in its use with physicians. We will discuss this issue as well as our major findings, contributions and limitations in Chapter 6.

CHAPTER 6

DISCUSSION OF FINDINGS

"I do not fear computers. I fear lack of them."

-Isaac Asimov

6.1 Introductions

This chapter will discuss in some detail our findings and how they compare to what we expected to find and to the results of previous TAM studies. Here we discuss the major findings, research contributions and limitations.

There were three major research questions in this study. First, the study attempted to determine the current use of the Internet by pediatricians in Hawaii. Descriptive statistics and the results of data analysis in chapter 5 provide preliminary evidence that pediatricians in Hawaii have are currently using the Internet in some capacity of their practices, but have not yet fully embraced such IHA as electronic medical records, email with patients and remote consultations. Pediatricians do however, possess and overall positive attitude toward the adoption and use of IHA, providing the technology is useful in accomplishing the routine tasks performed in their clinical practices. Second, the study examined the questions of whether educational interventions would increase physicians' intention to adopt IHA. Unfortunately, our small sample of treatment participants does not allow us to effectively answer this question based on our research. However, previous research (Chi Lum BI et al, 1999) provides evidence that exposure and hands-on training does increase physicians intentions to use the Internet in

their clinical practices. Our aim was to apply the evidence produced in that study to this research.

The final research question was an overall evaluation of TAM2's applicability in predicting physicians' intentions to adopt IHA. This question was addressed by conducting a test-retest analysis. We administered a modified TAM2 questionnaire via the mail a (T1) in March of 2001 and second TAM2 survey (T2) in June of 2001). Descriptive as well as regression analyses were performed to obtain results that could help answer the question of TAM2's applicability and to test the research propositions.

Empirically speaking, the more subjects used in a quantitative analysis the greater the generalizability of the results (external validity). Unlike previous TAM research, our sample size was limited to pediatricians in Hawaii and our subjects did not have hands-on experience with a technology, nor did each subject participate in the educational intervention and subsequently return a completed posttest questionnaire. For this reason, we did not pool subjects, which other TAM studies have done to increase the overall sample size for the regression analysis. A note of caution to the reader is to interpret these findings with discretion and within the context of a field study involving practicing physicians. By way of statistical standards, our sample size is considered small. In combination with the exploratory nature of this research and its importance to physicians' adoption of IT, our sample size adequately represents pediatricians in Hawaii and their intentions to adopt Internet-based health applications.

6.2 Major Findings

The results of this study indicated that:

1. TAM2 is appropriate, however not completely applicable in predicting pediatricians' as a professional group, intentions to adopt.
2. Perceived ease of use is not a determining factor for physicians' intentions' to adopt IHA.
3. Perceived usefulness is the strongest determinate of physicians' intentions to adopt and use an Internet-based health application
4. The cognitive instrumental processes were strong secondary determinants of physicians' intention to adopt
5. The social influence of subjective norm emerged significant only in the posttest analyses for physicians.
6. Hands-on experience is necessary in order to measure perceived ease of use in a study with physicians.

6.3 Discussion of Major Findings

In discussion of the complete applicability of TAM2 to physicians as a professional group, we begin with the reliability tests (Cronbach's alpha) of the measurement scales ranged from .72 to .92 reflecting high reliability. These reliability findings are consistent with previous TAM studies, specifically with TAM research involving physicians (Hu et al., 1999). Additionally, we conducted a test-retest for

reliability with the 52 pediatricians that completed both the initial survey and the second survey. Our results were consistent with those of Hendrickson, Massey and Cronan (1993) with the exception of perceived ease of use at (T2) which reported an alpha coefficient of .60. However, the remaining original TAM constructs were well within the acceptable level of reliability (Nunnally, 1978). All of the extended constructs (subjective norm, image, job relevance and output quality) indicated high reliability, across (T1-T2) with the exception of result demonstrability. This particular construct was consistent throughout this study in its low level of reliability. Hendrickson, Massey and Cronan (1993) did not conduct reliability analysis on the extended TAM2 because it was not published until 2000. For this reason we do not have a published test-retest comparison by which to discuss our result demonstrability reliability results. Although result demonstrability did not exhibit higher alpha coefficients, it did emerge significant in the multiple regression analysis as an influence on perceived usefulness.

Our multiple regression results were unlike the R^2 or variance results of the previously published telemedicine adoption study which were relatively low with perceived usefulness and attitude accounting for 44% of the variance in intention to use a technology (Hu et al., 1999, p. 106). Our adjusted R^2 for the pretest analysis explaining usefulness was .596, meaning that TAM2 explained nearly 60% of the variance in perceived usefulness. The pretest R^2 for intention to use was .588. Similarly, the posttest analysis for (N=52) was .642, meaning that TAM2 explained up to 64% of the variance in intention to use IHA. The variance explained by TAM2 in this study was much higher than that reported by (Venkatesh et al., 2000, p. 195), [between 37% and 52%]. It is also

52%]. It is also much higher than that reported by many TAM studies including (Davis et al., 1989 and Davis, 1989). Our results are similar to those reported by (Mathieson, 1991, p.184) [70%] in the comparison of TAM and TPB. In agreement with the findings of (Hu et al., 1999; Venkatesh et al., 2000) perceived usefulness was the strong determinant of intention to use and had a positive direct effect on intention to use with a standardized regression coefficient of 0.45. TAM2 explained 76% of the variance in perceived usefulness for the posttest analysis in this study again a higher percentage than that the [60%] reported by Venkatesh et al. (2000, p. 196).

In Venkatesh et al (2000, p. 199) the effect of subjective norm on perceived usefulness was significant at the times T1 and T2, but weakened at T3. It was reported that as individuals gained direct experience with a system over time, they relied less on social information in forming usefulness and intention but continued to judge a system's usefulness based on potential status benefits resulting from use.

Unlike the original TAM2 study, our subjects did not have direct experience with an information system, this seems to present a plausible reason why subjective norm did not have direct influence on perceived usefulness. However, subjective norm did have an effect on intention, during the posttest, which was consistent with the literature and our expectations. Perhaps it was the impact of the research sponsored educational intervention conducted by a respected pediatric colleague or a different workshop attended during that time frame that influence the significance of subjective norm to intention to adopt. Subjective norm is included as a direct determinant of behavioral intention in TRA (Fishbein et al, 1975) and TPB (Ajzen, 1991). The rationale for a direct

effect on subjective norm on intention is that people choose to perform a behavior, even if they are not favorable toward the behavior or its consequences. If, however, individuals believe one or more important referents thinks they should perform this behavior (i.e., adoption of IHA) and they are motivated they will comply with the referents. Interestingly, subjective norm had a positive effect on intentions to use for the posttest analysis, which was after the research intervention. Although our study did not accommodate a hands-on experiment, in either a voluntary or a mandatory setting, still the exposure to an IT via an important referent seemingly had an impact on the post adoption intentions.

Returning now to the discussion of perceived usefulness, in agreement with theory the cognitive instrumental processes (job relevance, output quality and result demonstrability) had significant effects on perceived usefulness in the posttest analysis. Job relevance, which is defined as a person's perception regarding the degree to which a target technology is applicable to his or her job tasks, remained significant across both sample sets. This suggests that pediatricians possess distinct knowledge about their job situations, which they use as a basis for determining what task, such as patient monitoring, prescription writing, charting, drug interactions, etc., can be performed with a given IT (Polson, 1987).

Similarly, result demonstrability, defined by Moore and Benebasat (1991, p. 203) as the "tangibility of the results of using the innovation", and remained significant throughout the posttest analyses. This implies that pediatricians formed a more positive

perception of the usefulness of IHA when they realized the relationship between usage and positive results were readily discernable.

Output quality, which we refer to as how well a technology performs tasks necessary to an individual's job goal was also a significant influence on perceived usefulness for the full posttest sample (N=75) and the subset sample (N=52) throughout the post analysis.

Image did not emerge as significant at any point in the study, very similar to perceived ease of use. Moore and Benebasat (1991, p. 195) define image as a "the degree to which use of an innovation is perceived to enhance one's . . . status in one's social system." Pfeffer (1982, p. 85) noted that by performing behaviors that are consistent with group norms, an individual "achieves membership and the social support that such membership affords as well as possible goal attainment which can only occur through action or group membership." TAM2 theorized that the increased power and influence resulting from the elevated status provides as general basis for greater productivity. In other words, if image were important to pediatricians, they would thus perceive that using IHA would lead to improvements in their job performance (in essence is the definition of perceived usefulness), which would be indirectly due to image enhancement. Our findings were unexpected, that image did not have an effect on perceived usefulness. The result are inconsistent with TAM2, which theorizes that identification, like internalization but unlike compliance, will occur whether the context of the system use is voluntary or mandatory. Identification did not occur in this research. Perhaps it is because there was not an actual system to use that would elevate their status among their peers, thus

improve their productivity. Another explanation comes through the suggestions offered by local pediatricians. Although the guest speaker is well respected in the field of pediatrics, he is not a part of the local culture of the Hawaii based pediatricians. Physicians are culture oriented as they have specific organizations and cliques they belong to according to their practice, medical specialty and status. Some local physicians felt that the Internet-based health information would have been better received, thus induced greater intention to adopt if coming from a local well respected opinion leader.

As mentioned earlier, a surprising and unexpected finding was the absence of an effect of perceived ease of use on perceived usefulness and behavioral intention. Perceived ease of use is defined as *the degree to which a person believes that using a particular system would be free of effort* (Davis, 1989). As discussed in chapter five, the basic TAM relationship of usefulness-intention was well supported, however the ease of use-usefulness and ease of use-intention relationships were not. This finding was not consistent with TAM theory. However, it is consistent with the results of Hu et al (1999), which found that perceived ease of use had no significant effect on attitude and perceived usefulness, in a study examining physicians' attitudes toward the acceptance of telemedicine. Their conclusion was that TAM may not be appropriate for user populations who have considerable above average general competence and intellectual capacity or have constant and reliable access to assistance in operating technology, (i.e., physicians). Other plausible explanations are that physicians may exhibit differences in general adaptability to new technologies, therefore ease of use is not applicable; and physicians characteristics and the nature of their work is considerably different from

students or subjects ordinarily examined in previous TAM research (Hu et al., 1999, p. 105). Lucas and Spitler (1999) conducted field study examining broker workstations they found no significant relationships between perceived usefulness and perceived ease of use and use for their full sample or for the two sub-samples (brokers and sales assistants). Moreover, they did find social norms and prior performance to be important predictors of use in the field setting. They concluded that in a field setting, organizational variables such as social norms and the nature of the job are more important in predicting use of the technology than are user's perceptions of the technology as theorized by TAM (Hu et al., 1999, p. 304).

The present findings lead us to concur with Hu et al (1999) in part, based on the characteristic differences of subjects typically examined in previous TAM research. Pediatricians are professionals and are specifically different from undergraduates, MBA's, clerical and administrative workers ordinarily tested.

William Goode (1957, 196) noted that two basic characteristics are sociologically relevant in explaining the professionalization of the physician: prolonged training in a body of specialized, abstract knowledge and an orientation toward providing service. Once a medical student begins training, he or she is expected to acquire a foundation of knowledge in the basic medical sciences and the techniques employed in the actual practice of medicine. Basic medical science studies consist of course in anatomy, biochemistry, physiology, pharmacology, microbiology, physical diagnosis, clinical laboratory procedures, and often behavioral science. The clinical programs consist of learning to use basic medical science and often technologies to solve clinical problems by

working with patients under the supervision of the faculty. The students rotate through clerkships in various medical services, such as surgery, pediatrics and obstetrics-gynecology and other specialties.

Due to such characteristics, Hu et al concluded that a positive perception of a technology's usefulness is vital to physicians' adoption, however the perception of ease of use may not be of equal importance for such professionals (1999). This finding could be a reflection of the model's limitation, or it could be an artifact of the research design.

The study did not involve direct hands-on experience with a target technology, nor did the previously mentioned telemedicine research. To this end, the technology was telemedicine in general, rather than a specific telemedicine program or technology (Hu et al, 1999, p. 96).

Although, our research provided an educational intervention, which exposed pediatricians to a specific IT, hands-on experience was not implemented, possibly leading to the absence of the theorized ease of use-usefulness relationships. However, using paired-sample T-test to examine the mean differences after the intervention, only two constructs differed significantly, perceived ease of use and output quality. This indicates that pediatricians' perceptions after attending the intervention differed significantly than before regarding output quality and ease of use. The results of the T-test lend support to the findings of Venkatesh and Davis (1996), with reference to how ease of use evolves with hands-on experience over time. *Based on a preliminary study, which found that before hands-on experience with a system, system characteristics did not play a significant role in the formation of early ease of use perception. However, after direct*

experience, system characteristics did become significant in determining ease of use perceptions. The findings suggest that understanding the antecedents of perceived ease of use is important from a theoretical standpoint because of its key role in determining initial acceptance and continued use. The results of the 3-experiment study indicated that there was a significant change in ease of use perception after hands-on use when compared to perceptions before hands-on use (1996, p. 466).

Subsequent research with physicians involving direct hands-on experience with an IT is imperative for theoretical implications as well as practical. Such research would allow a comparison of the present study and that of previous research involving physicians and TAM. Moreover, it is important to thoroughly understand the factors, which foster and inhibit physician's individual intentions to use an information technology. Lee (2000) found that physicians viewed an electronic medical record system less favorably than other professional groups. The majority of differences among the professional groups occurred in four dimensions: Compatibility, Relative Advantage, Ease of Use, and Image. The physician groups had lower scores in these dimensions than many of the other groups. In the case of Compatibility, Ease of Use, and Image, the physician scores were all below 4.00. For Relative Advantage, the physician group scored 4.33. Lee's findings are consistent with our results. Physicians are more concerned with the relativity, advantages and usefulness of a system, such as an EMR will provide as opposed to ease of use or image. The ease of use scores was significantly different between the administrative personnel and the three clinical professional examined: MD's, residents, and RN/NPs. Administrative personnel are currently using

computers and computer systems in their jobs. The registration system and scheduling systems for the clinics are computerized. Lee suggest that this may account for administrative personnel's' perception the EMR system will be easy to use, versus the physician groups' perception that it will not be so easy to use. Professional nurses had somewhat neutral perceptions of the ease of use, but they viewed the EMR as less easy to use than did the administrative personnel (2000).

Although, our overall sample size was small, and the perceived ease of use constructs of TAM was not supported, regression analyses indicated that TAM2 was appropriate in explaining 64% of the variance in intention to use/adopt and 75% of the variance in perceived usefulness. Table 6.1 presents a summary of the results of the research proposition.

Table 6.1. Research Proposition Results

Propositions	Results	
	Pretest	Posttest
P1: Subjective norms will have a positive effect on perceived usefulness	NS	Supported
P2: Image will have a positive effect on perceived usefulness	NS	NS
P3: Job Relevance will have a positive effect on perceived usefulness	Supported	Supported
P4: Output Quality will have positive effect on perceived usefulness.	Partially Supported	Supported
P5: Result demonstrability will have positive effect on perceived usefulness	NS	Supported
P6: Perceived ease of use will have a positive effect on perceived usefulness	NS	NS
P7: Intention to use measures taken after the educational intervention will differ significantly from those taken prior to the intervention	NS	

* NS means not supported

We performed an ANOVA to compare means on the educational intervention; we found no significant difference in the 52 pediatricians that completed both, the pretest and posttests. As mentioned earlier, output quality and perceived ease of use demonstrated significant difference among the eight pediatricians that attended the research intervention. There was no significant difference in any of the variables on either of the other treatments (different workshop and no workshop). This damper on our results may be a methodological shortcoming associated with conducting a field study.

6.4 Contributions and Implications

The application of computers and Internet technology to health care and its delivery holds promise of improving human existence; many of the benefits are beyond dispute. However, there are problems that must be addressed before the full potential of IHAs can be realized (Burke and Weill, 2000). Problems such as, privacy, security of medical records, the increasing importance of financial motives that HMO's bring and the attitudes toward adoption. This study presents research examining the applicability of TAM2 to explain pediatricians' intentions to use Internet-based health applications. The theory was evaluated using data collected from 164 pediatricians practicing in Hawaii. Our contribution to knowledge is to the wealth of information systems literature with relative and new information regarding the adoption intentions of a professional group that is not commonly examined in IS research - physicians. Our second contribution is actual results of the test-retest of TAM2. To our knowledge, no other study has evaluated TAM2 in the professional context of physicians or performed a test-retest to evaluate the

reliability of the extended instrument. Our findings also present practical implications for the health care industry.

We begin the discussion first with social influences (subjective norm and image), which had a positive effect on intention and usefulness respectively, in the posttest analysis, even in the absence of an actual system and mandatory usage. This demonstrates that social information and possibly group identification is more influential on intentions to adopt than perceived ease of use. Cockerham contends that physicians constitute less than 10% of the total medical workforce, yet the entire health care industry in the United States is usually subordinate to their professional authority in clinical matters and research (1998, p. 182). The social importance of the medical function and the limited number of people with the expert training to perform, as physicians are not the *only criteria* explaining their professional dominance. The organization of the medical profession itself is an important factor. Goode indicates that once a professional group, such as physicians begin to consolidate its power by formalizing social relationships that govern interaction of the professionals with their clients, their colleagues, and with *official agencies outside the profession; recognition on the part of the clients and the wider society of the physician's claim to competence* is necessary (1960). Hall (1948) contends that a doctor's career takes place in a system of formal and informal relationships with colleagues. Formal relationships develop because of a physician's *position within the prevailing medical institutions in a particular community*. Informal relationships also develop over time as physicians interact with one another frequently and arrive at definitions of the quality of each other's work and personal characteristics.

Hu et al was accurate in their characteristic assessment of the differences between physicians and the ordinary TAM participants (1999). To this end, this research provides support to the IT acceptance literature and finds the need for future research that thoroughly investigates the social influence processes of identification and internalization on physicians' intention to adopt an innovation.

With this in mind, this research is significant for the adoption of IT in health care. Health care providers, IT developers and vendors, insurers and other delivery groups must reach beyond examining physicians' care delivery practices but should pay attention in the pre- and early implementation phase to their technological and sociological perspectives.

The major theoretical contribution of this study is the advancement of knowledge in *IT adoption literature*. The results provide a greater understanding of the extended technology acceptance model in a context unlike that which it is normally tested. The relatively high R^2 values in our model compared with prior TAM studies suggests that TAM2 is a robust and reliable model, which can be used effectively within the health care environment with additional modifications.

TAM has been identified as an IT acceptance model which is good at characterizing individuals, but not organizations or particular groups. Our findings suggest that the pediatricians in this study were possibly operating as a group, particularly on posttest analysis. There are several plausible explanations for this result, 1) the intervention could have had an impact on pediatricians' social influences processes, 2) physicians really are characteristically different and operate as group in formal and

informal situations or 3) our sample size was so small as to bias the results. Whatever the reason, we recommend a replication of our study using cross-section physicians on a larger scale and employing hands-on experience would provide a richer explanation for how physicians operate when contemplating IT adoption.

Additionally, TAM2 was modified for this study to address such issues as privacy, security, confidentiality, legal issues, and reimbursements. Labeling these concerns as “significant barriers” allowed us to incorporate them into the intention to use scales. The term, significant barrier was explained in the questionnaire prior, to the TAM2 scales. As a result of scale reliability and high percentage of variance explained by the model we contend that these modifications to TAM2 contribute to the development and test of TAM2 and advances theory on this important issue of physicians’ adoption of information technology.

The practical contributions for healthcare organizations and IT system designers consists of understanding that physicians do not operate in the same sense as administrative workers when deciding whether to use an information technology innovation or not. The research suggests that physicians choose to use a system based on its usefulness and the relative advantage that it produces in performing daily tasks. Ease of use and social influences are not determining factors in a physician’s intention to use and ultimate usage behavior. System designers would do well to work with physicians to engineer systems that are specific to their task. Often system designer build systems on their own personal assumptions of what the user needs. This mode of design and production is not sufficient when creating information systems to be used in

healthcare, particularly by physicians. To this end, the TAM2 theory is not completely efficient or sufficient when evaluating physicians' intentions because the underlying theory makes assumptions that are far different from the needs and specifications of physicians and other healthcare staff. TAM2 does not take into considerations, physicians' perceptions on security, confidentiality, HIPPA compliance, and ethical issues surrounding a physician's use of the Internet. For this reason, we propose additional research that would incorporate these crucial elements to the existing TAM2. This type of research may lead to an even more extended TAM2 or perhaps an entirely new model that would be specifically designed for physicians.

The overall implications of our study are as follows:

- With the exception of result demonstrability, TAM2 exhibits adequate test-retest reliability.
- Physicians are more practical than the average TAM subject and rely heavily on the usefulness of a technology rather than ease of use.
- No amount of ease of use can substitute for the technology's usefulness in performing physicians' daily tasks.
- Initially physicians operated as individuals in their IT acceptance intentions, however either social influence or the mere passing of time effected physicians post analysis subjective norm perspective.

To conclude the contribution discussion, we also collected qualitative data during this study to capture individual differences, which is being analyzed for a future qualitative investigation, which will extend the present research.

6.5 Limitations

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

- *Small sample size*
- *Field study as opposed to a lab experiment*
- *Methodological shortcomings*
- *No hands-on experience trial for subjects*
- *Mail survey*
- *Two-item scales*
- *Use of 5-point liker scale rather than 7-point*
- *Survey needed an explicit explanations of the Internet and the WWW*
- *Need for a qualitative case study*
- *The use of a popular IT model, that was not specifically designed to evaluate the unique needs of the healthcare industry*

First, the study's sample was limited to pediatricians practicing in Hawaii. As such, the research needs to be replicated to examine the robustness of the findings across

a larger sample size. Second, while an effort was made to examine non-response bias, there is always the possibility that data are somehow systemically biased. Third, the methodology for this study presents certain constraints. A field study does not allow for the same controls afforded to an investigator conducting as a laboratory study. For this reason, our posttest response rate of pediatricians attending the research seminar was poor. Had we administered the survey immediately after the “grand rounds” lecture the results of the treatment evaluation may have shown a significant difference in the research variables. Further, we were unable to provide the subjects with hands-on experience of a target technology. *An experimental replication of these findings involving hands-on experience may provide evidence to the key perceived ease of use-perceived usefulness relationship.* Fourth, mail questionnaires typically have the lowest response rates, although our response rate was increased by persistent postcard mailings and follow-up phone calls. Fifth, several of the constructs were measured with only two items. Although the two-item scales were consistent with literature and exhibited adequate reliability, a step toward future research would be the constructing and testing additional items for TAM2. In retrospect, we realize the mistake of decreasing the 7-point likertscale to a 5-point scale because of our pilot test. A 7-point scale would have allowed for more variability in the TAM2 responses.

Follow up interviews with physicians that participated in the study suggested that our next questionnaire explicitly explain the differences between the Internet and the World Wide Web. Many physicians believe the two to be one in the same and may have been confused by some of our questions.

Additional knowledge regarding the underlying factors that foster a physician's intention to adopt may materialize by using a mixed methods approach (qualitative and quantitative). In-depth interview with physicians across all specialties would provide rich information that could lead to better understanding physicians' behavioral characteristics, IT needs, desires, dislikes, computer efficacy, etc. This type of information would allow researchers to design an adoption model that would be tailored to the physician and their particular specialty.

Our final limitation is perhaps using "a franchise type theory" to evaluate a very unique target population. TAM has been well researched and use in various settings and with diverse technologies. However, until Hu et al (1999) TAM had not been evaluated with physicians. Our results are consistent to that of (Hu et al., 1999 & Chau & Hu, 2002) with respect to the fact that a physician sensitive model would have produced more conclusive and concrete results.

Although the results of this study may not be generalizable beyond pediatricians in Hawaii, the study provides a framework for future research. A natural expansion of this study would be to conduct a case study incorporating Delphi techniques, an iterative procedure for obtaining subjective information from professionals and medical experts (physicians). In chapter 7, we present our summary and recommendations for future research.

CHAPTER 7

CONCLUSION

"Things turn out best for those who make the best of the way things turn out."

-James D. Logan

7.1 Summary

This research examined the current use of the Internet by pediatricians in Hawaii. It also evaluated TAM2, which was found to be appropriate but not entirely applicable in the health care context. The test-retest results show over reliability with the exception of result demonstrability. The result demonstrability findings are consistent with that of Moore and Benbasat (1990). They did not find result demonstrability to be significant, which they explained became less important after adopting the technology. Our core TAM construct findings are consistent with that of previous research (Davis, 1989; Venkatesh & Davis, 2000; Hu et al., 1999). Unexpectedly, ease of use did not appear to be a significant factor that influenced the intent to use IHA. Although this result is inconsistent with much of the TAM research, the insignificant finding of ease of use is consistent with the results of Moore and Benbasat (1990) and Benbasat, H. (1994). These authors conclude that the insignificant findings of ease of use may be a factor that plays a more instrumental role after one starts hands-on trials and/or use of the technology. Our study did not implement an actual technology system, this may account for the lack of significant perceived ease of use findings (Venkatesh et al, 1996). It may also be a result of the methodology, healthcare context or subjects' unique professional characteristics. However, the ease of use and social influence results were not consistent

with the established TAM2 theory. Our goal is to further investigate these factors by replicating the present study. We will remove the methodological shortcomings to examine the perceived ease of use- perceived usefulness-intention relationship.

The research results indicate that Pediatricians in Hawaii are currently using the Internet in their clinical practices on a limited basis and they generally have positive attitudes toward the adoption of IT.

There were no significant difference found across the use Internet-based health applications and practice size, age group or level of computer knowledge. Contrary to a popular belief, age was not a significant determinate of use. While larger practices did report using the Internet more, smaller practices in Hawaii are not significantly different in their use. The large number of solo practices in Hawaii may possibly explain these results. Nationwide only 10.6% of the American Academy of Pediatrics members was in solo practices versus 42% for those in Hawaii (<http://www.aap.org/research/ps43aexs.htm>).

Our results indicate that physicians as a group are not techno phobic or afraid of information technology use in their clinical practices. However, physicians are pragmatic and their adoption intentions are heavily influenced by perceived usefulness, job relevance and quality of output of a system. Physicians as a professional group are unique in their characteristics toward adoption therefore to better examine their behavioral intentions unique IT measurements must be developed with their specifications embedded.

7.2 Recommendations and Future Research Directions

An overall recommendation is to continue research that leads to the improvement of TAM2 and other technology acceptance models. It is imperative that IT and information system researchers develop theoretical models that are specific to physicians and the health care sector. No one model can ever be the complete answer to all of society's needs. Dixon et al (2000) has begun development of an information technology adoption model for health care. This is a move in the right direction, however they too incorporate the core premises of TAM.

It is our recommendation that additional items be constructed, tested, and added to the measurement scales of intention to use, subjective norms and job relevance of TAM2. The present study included two additional items to the output quality construct with a resulting Cronbach's alpha coefficient of .86. The additional items to TAM2 will allow for structural equation modeling and confirmatory factory analysis.

We also recommend continued investigation into the effect of social influence processes. Subjective norm became significant for pediatricians after the educational intervention. We contend that this result was due to the mere passing of time. However, in a follow up interview, one pediatrician discussed sharing the information about the intervention with other colleagues. Research indicates that communication has been documented as a key factor in the adoption of technology (Rogers, 1983). Peers tend to have a significant influence on the behavioral intentions of each other. The transfer of ideas occurs most frequently and effectively between individuals who are alike. Brancheau and Wetherbe (1990) also noted that interpersonal channels of communication

were dominant in all phases of adoption and decision-making. Further investigation of social influences may help provide insight on whether physicians operate as a group or as individuals when contemplating IT adoption. We concur with the literature that as the adoption decision becomes more of a team- rather than individual-level decision, the nature and role of social influence processes will need to be evaluated beyond the present TAM2.

In an effort to ensure the success of IHA in clinical settings, organizations and healthcare management should apply similar strategies to those reported by Davidson and Chismar (1999). The research organization under study made several critical decisions that helped to facilitate the successful use of a computer order-entry system (COE). First, the vision for IT use at the hospital was aligned with the health care system's strategy (p. 59). The researchers found that the most significant decisions were those to make the COE project, physician-led and aligning the initiative with clinical rather than administrative, authority structures. This was crucial to gaining the physicians' acceptance and use of the system. It is evident by the lack of significance of the ease of use construct in the present study, that physicians' attitudes toward the adoption of IHA was not based upon the amount of effort required to use the system, but rather the usefulness of the system influenced by the cognitive instrumental processes and the social influence processes. The direct involvement of physicians at the design, pre-implementation and implementation stages of new IHA would increase their level of acceptance, thus use in their clinical practices.

Additionally, Davidson and Chismar (1999) reported that if significant changes in physicians' roles and practice patterns were anticipated from the use of a COE, then system sponsors found ways to ensure that physicians take a leading role in system implementation.

Combining organizational theories such as the principles of Rogers' (1983) diffusion of innovation, we recommend more fieldwork and case studies as a future trend of TAM2 research. The nature and results of such investigations will help to build and elevate the extended technology acceptance model toward the next level of physician-centered and team-based adoption.

In conclusion, physicians' acceptance and use information technology in their clinical practices remains an important phenomenon. Computers and the Internet in health care can have an enormous positive effect on the quality of care delivery. However, before the promise of information technology can be realized, such concerns, as security, privacy, ethics, and attitudes toward adoption must be addressed. This research sets the groundwork for such future IT and healthcare endeavors.

APPENDIX A

TAM2 Measurement Scales and Reliabilities (Venkatesh & Davis, 1999)

Intention to Use (Cronbachs ranged from .82 to .97 across studies and time periods)

Assuming I had access to the system, I intend to use it.

Given that I had access to the system, I predict that I would use it.

Perceived Usefulness (Cronbachs ranged from .87 to .98 across studies and time periods)

Using the system improves my performance in my job. Using the system in my job increases my productivity. Using the system enhances my effectiveness in my job. I find the system to be useful in my job.

Perceived Ease of Use (Cronbachs ranged from .86 to .98 across studies and time periods)

My interaction with the system is clear and understandable.

Interacting with the system does not require a lot of my mental effort.

I find the system to be easy to use.

I find it easy to get the system to do what I want it to do.

Subjective Norm (Cronbachs ranged from .81 to .94 across studies and time periods)

People who influence my behavior think that I should use the system.

People who are important to me think that I should use the system.

Voluntariness (Cronbachs ranged from .82 to .91 across studies and time periods)

My use of the system is voluntary.

My supervisor does not require me to use the system.

Although it might be helpful, using the system is certainly not compulsory in my job.

Image (Cronbachs ranged from .80 to .93 across studies and time periods)

People in my organization who use the system have more prestige than those who do not.

People in my organization who use the system have a high profile.

Having the system is a status symbol in my organization.

Job Relevance (Cronbachs ranged from .80 to .95 across studies and time periods)

In my job, usage of the system is important.

In my job, usage of the system is relevant.

Output Quality (Cronbachs ranged from .82 to .98 across studies and time periods)

The quality of the output I get from the system is high.

I have no problem with the quality of the system's output.

Result Demonstrability (Cronbachs ranged from .80 to .97 across studies and time periods)

I have no difficulty telling others about the results of using the system.

I believe I could communicate to others the consequences of using the system.

The results of using the system are apparent to me.

I would have difficulty explaining why using the system may or may not be beneficial.

Note: All items were measured on a 7-point Likert scale, where 1=strongly disagree, 2=moderately disagree, 3=somewhat disagree, 4=neutral (neither disagree nor agree), 5=somewhat agree, 6=moderately agree, and 7=strongly agree.

APPENDIX B

Modified TAM2 Questionnaire

We are interested in your attitude toward the use of Internet-based Health Applications (IHA). Internet Health Applications cover a range of possible systems including: Electronic Medical Records, Email, Electronic Billing, Patient Scheduling, Patient Monitoring, Remote Consultations, Public Health Surveillance, etc.

Please indicate how strongly you agree or disagree with the following statements.
Using a 5 point Likert-scale ranging from (1) Strongly Disagree to (5) Strongly Agree

1. IHA could reduce the cost of my care delivery.
2. IHA could increase my productivity.
3. Assuming that significant barriers to the use of IHA are overcome, I intend to use IHA.
4. My interaction with IHA will be clear and understandable.
5. IHA could improve the quality of care that I deliver.
6. IHA will be easy to use.
7. Pediatricians who influence my behavior think I should use IHA.
8. If significant barriers did not exist, I predict I would use IHA.
9. Having IHA will be a status symbol.
10. Usage of IHA is relevant to the delivery of pediatric care.
11. IHA could enhance my effectiveness.
12. Interacting with IHA will not require a lot of mental effort.
13. Pediatricians who are important to me think I should use IHA.
14. It will be easy to get IHA to do what I want them to do.
15. IHA could be useful in my job.
16. Pediatricians who use IHA have more prestige than those who do not.
17. The quality of consumer health information on the Internet is high.
18. I believe I could communicate to others the consequences of using IHA.
19. Usage of IHA is important to the delivery of pediatric care.
20. The quality of pediatric information currently on the Internet is high.
21. Pediatricians who use IHA have a high profile.
22. The results of using IHA will be apparent to me.
23. The quality of professional information on the Internet is high.
24. I would have difficulty explaining why using IHA may or may not be beneficial.
25. I expect the quality of future IHA to be high.

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