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Understanding Physician Use of Online Systems: An Empirical Assessment of an Electronic Disability Evaluation System

Thomas A. Horan, Bengisu Tulu, Brian Hilton

School of Information Science
Claremont Graduate University

130 E. Ninth Street,
Claremont, CA 91711, USA

Phone: (909) 607-9302

Fax: (909) 621-8564

{tom.horan, bengisu.tulu, brian.hilton}@cgu.edu

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Abstract

This chapter develops a conceptual model for physician acceptance and tests this socio-work structure model using a nationwide survey of physicians (n=141). The domain focus of this study is physician acceptance of online disability evaluation systems for generating and managing medical examination reports. The survey measured whether behavioral intention to use the new system varied as a function of IT infrastructure, organizational processes relating to IT, physician experience with computer use in clinical settings, and both specific and general attitudes toward IT use in clinical settings. Survey findings suggest that each of these factors affects behavioral intent to use online disability evaluation systems, and that these factors are more important than generalized attitudes toward online systems or socio-demographic predictors. Findings suggest that work-practice variables are important when considering physicians use of online systems. The chapter concludes with a discussion of implications for devising advanced testing systems that can be used to ensure active physician participation in medical informatics systems

INTRODUCTION

The use of computers for information management and decision support in the medical field dates back to early mainframe use in large hospital settings (e.g., PROMIS) (Westberg & Miller, 1999). In today's world, managed care has created a flood of information for hospitals and medical practices in which patients see many different medical practitioners during the course of medical treatment. As a result, storage of information regarding a patient becomes distributed and requires access by many different stakeholders at any given time. In the disability evaluation environment, there are myriad histories, assessments, treatments, and correspondences, the management of which places the physician in the role of "information manager". A major source of this complexity is that these activities often employ different terminology to describe the same functional characteristics of the disability in question (Demeter, Andersson, & Smith, 1996). For instance, a treatment-oriented assessment may use one terminology while a financially-oriented legal assessment uses a very different terminology. Additional complexities arise when physicians need to spend valuable time attempting to clarify these translations as a precursor to their own assessment. As a result, disparate and often insufficient data is collected along with attendant but unnecessary paper work. These inefficiencies occur especially in the medical evidence collection phase. Indeed, the process of gathering the necessary medical evidence to render a legal judgment can easily create a recursive loop that significantly lengthens the decision process by several years.

This chapter reports on a research study that examined technology acceptance of an online disability evaluation system, which is used by physicians as an integral part of the disability assessment process[1]. The first part of the chapter provides a conceptual overview of the inquiry, beginning with a brief review of literature pertinent to physician

[1] Various Findings from this research project have been reported in (Horan, Tulu, & Hilton, 2004; Horan, Tulu, Hilton, & Burton, 2004; Tulu, Hilton, & Horan, 2003).

acceptance of technological systems, and then progresses to outline a conceptual model for assessing a physician's behavioral intent to adopt a new online system. The chapter then analyzes data using both descriptive and multivariate analyses, specifically path analysis, from a nationwide survey of physicians. The final section attends to the research and practice implications of the survey findings.

CONCEPTUAL OVERVIEW

In their role as information manager, physicians need to recognize when it is necessary to seek additional information sources rather than rely primarily on past experience, stored cognitive knowledge, or heuristics (Westberg & Miller, 1999). Information systems (IS) are designed specifically to handle this type of organizational environment where computer systems and software applications can synthesize information, provide diagnostic support, and create knowledge repositories that aid physicians. Therefore, it is important to understand the physician decision-making process in order to design an IS that can support this process. This section starts with the physician decision making literature, and continues with the related literature regarding the use of IS to support decision making including studies relating to physician resistance to use of IS, mediating factors for resistance and use, and the latest studies that report no resistance to "good change". A consideration of how medical informatics systems can be viewed in terms of the Task-Technology-Fit literature review concludes the overview section.

Work Practice Considerations of Physicians

Patel, et al. (V. L. Patel, Arocha, & Kaufman, 2001) provides a framework for analyzing medical cognition - a sub-field of cognitive and decision science devoted to the study of cognitive processes inherent in medical tasks. This framework provides constructs regarding expert decision-making at various levels. Their work asserts, “medical knowledge can be constructed as a hierarchically ordered conceptual system that serves to partition problems into manageable clusters of information”. Physicians have the task of making many types of decisions in their daily work routine. These decisions are often complex decisions that require large amounts of information requiring tools and aids to assist in synthesizing the information. Physician decision-making tasks can be located on a continuum ranging from structured, semi-structured to unstructured decision-making. The structured decision-making process involves decisions that have been previously evaluated by experts in the field (McKinlay, Potter, & Feldman, 1996). Physicians merely follow a series of steps to arrive at the appropriate decision outcome (Ryan, 1998). The semi-structured process involves a combination of processes that have been previously evaluated and implemented and those that are of an unstructured nature. According to McKinlay, unstructured decision making is exponentially more complex than the structured decision-making task. (McKinlay et al., 1996). Many variables contribute to the complex nature of unstructured decision-making, such as, large numbers of decision alternatives, highly variable outcomes or consequences of the decision alternatives, multiple decision makers involved in the decision-making process, and high stakes for decision consequences. In the case of disability evaluation, decision-making is a relatively structured process in that the requisite steps required to complete the process is pre-defined, leaving physicians with fewer unstructured decisions to consider.

Factors Affecting Physicians' Acceptance and Use of Decision Support Systems in the Clinical Setting

There have been patterns of resistance to use of IS in the medical community (Johnston, Leung, Wong, Ho, & Fielding, 2001; Mikulich, Liu, Steinfeldt, & Schriger, 2001), with considerable attention to factors which inhibit and/or facilitate acceptance by physicians. Current literature suggests that physicians' resistance is most acute when considering Clinical Decision Support Systems (CDSS) in clinical practice (Johnston et al., 2001; Ridderikhoff & Van Herk, 2000). To identify the prevailing attitudes associated with the adoption of computers in clinical practice among physicians in Hong Kong, Johnston, et al. (Johnston et al., 2001) performed an empirical investigation surveying 4,850 randomly selected physicians. The survey focused on the details of the physicians' practice, actual computerization of or intention to computerize clinical functions, attitudes towards computerization, self-perceived computer ability, self-perceived knowledge, and demographic information. Research indicates that many potential psycho-social variables continue to be obstacles for physicians' acceptance and use of decision support systems in the clinical setting (Johnston et al., 2001). Perceived high implementation costs, added requirements for staff training (Bomba, 1998; Mitchell & Sullivan, 2001), relevance (Schuring & Spil, 2002), managing change (Nielsen, 1998), the disruption to practice (Ridsdale & Hudd, 1994), perceived negative impact on doctor-patient communication (Ridsdale & Hudd, 1994; Thakurdas, Coster, Curr, & Arroll, 1996), and increased pressure on physicians to function in an ever changing, increasingly complex world of medicine (Greatbatch, Heath, Campion, & Luff, 1995; Mitchell & Sullivan, 2001), are some issues that continue to contribute to physician resistance to the acceptance and use of CDSSs.

It is clear that a gap exists between the intended use of CDSSs in the clinical setting and the actual usage of the system by the physician. Research has shown that there are unexplored variables that mediate and moderate physicians' resistance to the use of CDSSs in the clinical setting, even when the use of the system creates a more accurate assessment than does the physician without the use of the CDSS (Johnston et al., 2001; Kaplan, 1997; Kaplan, Brennan, Dowling, Friedman, & Peel, 2001; Leung, Johnston, Ho L., Wong, & Cameo, 2001; Ridderikhoff & Van Herk, 2000). For example, an empirical study was conducted where physicians were required to use a computer system to solve a number of clinical patient problems with the help of a diagnostic decision support system (Ridderikhoff & Van Herk, 2000). Although 75% of the participants believed that computers were useful in daily clinical work, only two-thirds of the group could imagine a theoretical possibility of computers supporting physicians in their diagnosis. Of greater interest was that, in those cases where the physicians' diagnosis was incorrect and the system's differential diagnosis was correct, the physician did not reconsider his/her own diagnostic opinion. When asked for their opinion about the system's differential diagnosis, the participants indicated they found it very useful when the system confirmed their diagnosis but marginally relevant to their judgment when the system refuted their diagnosis.

In order to gain a greater understanding of the factors that contribute to physician resistance, it must be recognized that resistance to change is a result of technical and social impact (Spil, Schuring, & Katsma, 2002). While there is considerable evidence regarding the hesitancy that a physician may have toward the use of IT, recent research suggests that such hesitancy is a function of specific system expectations. Spil et al. reported that although resistance is claimed to be ***the*** determinant of IT use by researchers, it is merely the cumulative consequence of other effects which prevents physicians from using IT (Spil et al., 2002). Previous research also found that physicians have positive attitudes about using information systems to access up-to-date knowledge, for continual medical education, for access to healthcare in rural and remote areas, for improving quality of patient care, and for interaction within a healthcare team (Pare & Elam, 1999). It is reported (Pare & Elam, 1999; Spil et al., 2002) that there should be no resistance to a change that can be perceived as "good change". Therefore, it is important to understand the factors that contribute to resistance in order to increase the use of IT among user groups. This is especially true in terms of understanding structured versus unstructured decision making and the tasks that can be supported through the use of IT.

Task-Technology Fit (TTF)

There is often a gap between the requirements of physicians' tasks and the functionality of decision support systems that can aid in these tasks (Schuring & Spil, 2002). Early identification of the discrepancies between user requirements and system functionality (requirements-functionality gap) is often the key factor to be addressed in the design of information systems.

Current work in the area of Task-Technology Fit (TTF) underscores the need for more research into the requirements-functionality gap. Lucas, et al. (Lucas, Walton, & Ginzberg, 1988), suggest that research should be conducted to explore more fully the role of discrepancies and to identify variables, which reflect the differences between system features and the user's needs. Goodhue and Thompson (Goodhue & Thompson, 1995) suggest that TTF is an excellent focus for developing a diagnostic tool for analyzing how information systems can support various tasks in an organization. Specifically, they recommend that it be detailed enough to more specifically identify gaps between systems capabilities and user needs. In 1995, Goodhue (Goodhue & Thompson, 1995) showed that users can successfully evaluate TTF and that carefully developed user evaluations can be crafted to measure TTF. This study also concluded that the value of a technology is dependent upon the tasks of the user. Zigurs, et al. (Zigurs, Buckland, Connolly, & Wilson, 1999) researched the linkage between TTF and Group Support Systems (GSS). As part of this research, they developed profiles of the relationship between group tasks and GSS technology, and demonstrated the relative impact the TTF model had on group performance. They found that the higher the TTF, the better the groups performed. Dishaw (Dishaw, 1999) extended the TTF model further by showing a relationship between the TTF model and variables from the constructs in the Technology Acceptance Model (TAM). The TAM model states that, for technology to be used, the user must perceive that it is easy to use (perceived ease of use) and that it will be useful (perceived usefulness). Dishaw's research shows that an increase TTF has a direct impact on perceived ease of use and an indirect impact on perceived usefulness.

There is little existing research that focuses on the Task-Technology Fit of CDSS for physician work system practices and work practice compatibility (Kaplan et al., 2001). Consequently, this is an area of research that must be addressed in order to gain a broader understanding of physician acceptance of IT in medical practice.

In short, this literature review underscores the value in empirical investigations of the acceptance and use of clinical decision support systems in a manner that refines and extends traditional theories of technology acceptance and diffusion such as the Technology Acceptance Model (Davis, 1989), The Theory of Planned Behavior (Ajzen & Fishbein, 1980), and the Theory of Reasoned Action (Godin & Kok, 1996). However, this empirical study goes beyond the usual measures of systems performance to focus more on the social and behavioral patterns physicians' employ, such as work practice compatibility or organizational and technical readiness, when deciding to accept or use a CDSS in practice. Further, this study aims to bring this notion of "fit" together with concepts from technology acceptance and reasoned action and to do so in a manner that explains the specific behavioral intentions for a specific type of relatively structured decision making regarding online disability evaluations.

RESEARCH DESIGN

Technology Acceptance Models

A number of technology acceptance models such as Roger's diffusion of innovations model, Kwon and Zmud's diffusion/implementation model, and Davis's Technology

Acceptance Model (TAM) have been developed (Kwon & Chidambaram, 2000). Of these, the TAM has been the focus of many Information Science researchers and practitioners over the past twenty years and has been used as tool regarding the adoption of Information Systems by organizations and individuals (see the related chapter of this volume).

The premise of the TAM is that users' attitudes towards new technologies are shaped by two related factors: Perceived Usefulness (PU), and Perceived Ease of Use (PEOU). That is, PU (the degree to which a person believes that using a particular system would enhance their job performance) exerts an influence on users' PEOU (the degree to which a person believes that using a particular system would be free of effort). This model has been applied in a number of organizational environments and has been a reliable predictor of users' actual actions, especially among university students and business executives (Chau & Hu, 2001; Kwon & Chidambaram, 2000). However, Succi and Walter (Succi & Walter, 1999) raise some questions whether TAM can predict the attitudes of physicians towards new IT because of the unique knowledge intensive circumstances surrounding medical decision making.

The Theory of Planned Behavior (TPB) attempts to overcome some of the limitations of the TAM by incorporating additional factors that may influence an end-users' decision to use the technology over and above their initial perceptions. In particular, Chau and Hu (Chau & Hu, 2001) introduced an important new construct, Compatibility (the degree to which the use of the new technology is perceived by a person to be consistent with their work practices). Chau and Hu (Chau & Hu, 2001) argued that the physicians in their study would be more likely to consider technology useful if they perceived it to be compatible with their existing work practices. In addition, physicians would consider technology easy to use if they did not need to change their work practices significantly and hence, Compatibility can be seen to favorably affect a physician's attitude toward accepting new technology.

Another extension to TAM was proposed by Mathieson et al. (Mathieson, Peacock, & Chin, 2001) and examined the influence of perceived user resources. They examined perceptions whether adequate resources can facilitate or inhibit how well individuals perceive they can execute specific courses of actions. Their study was motivated by the fact that TAM assumes usage of an information system is voluntary and achievable. However, barriers may exist and may inhibit an individual from using a system even if they are inclined to do so. In relation to this study, the technology needs to be considered within the context of the physicians' practice. Moreover, given the fact that a physician's main focus is not technology; it is reasonable to expect that their office may not be technically or organizationally equipped to utilize new systems. As a result, the introduction of a new technology in this environment can be disruptive to their current workflow. Therefore, it is important to consider these two constructs in addition to TAM model.

Research Model

An analysis of physicians' use of the on-line system employing the same constructs that are traditionally used in TAM and TPB was performed. However, a new dimension to the model was added by including variables that capture work system practices such as computer related activities within the current work practice system and environment. Whereas the TAM and TPB models focus primarily on individual use of technology in a medical practice, this research explored the components of organizational and work systems practices and their influence on users' behavioral intent to use systems. Moreover, this research examined whether these components exert a stronger influence on a physicians' willingness to use an on-line system compared to the individual user constructs traditionally studied using TAM and TPB models. Figure 1 illustrates a modified version of TAM to include constructs that capture the organizational and work practice variables that will aid these models in better explaining user acceptance and identifying possible change management strategies. The independent variables are grouped into four categories as shown in Figure 1: A) Social- Demographic, B) Organizational/Technical Readiness, C) Attitude, and D) Work Practice Compatibility.

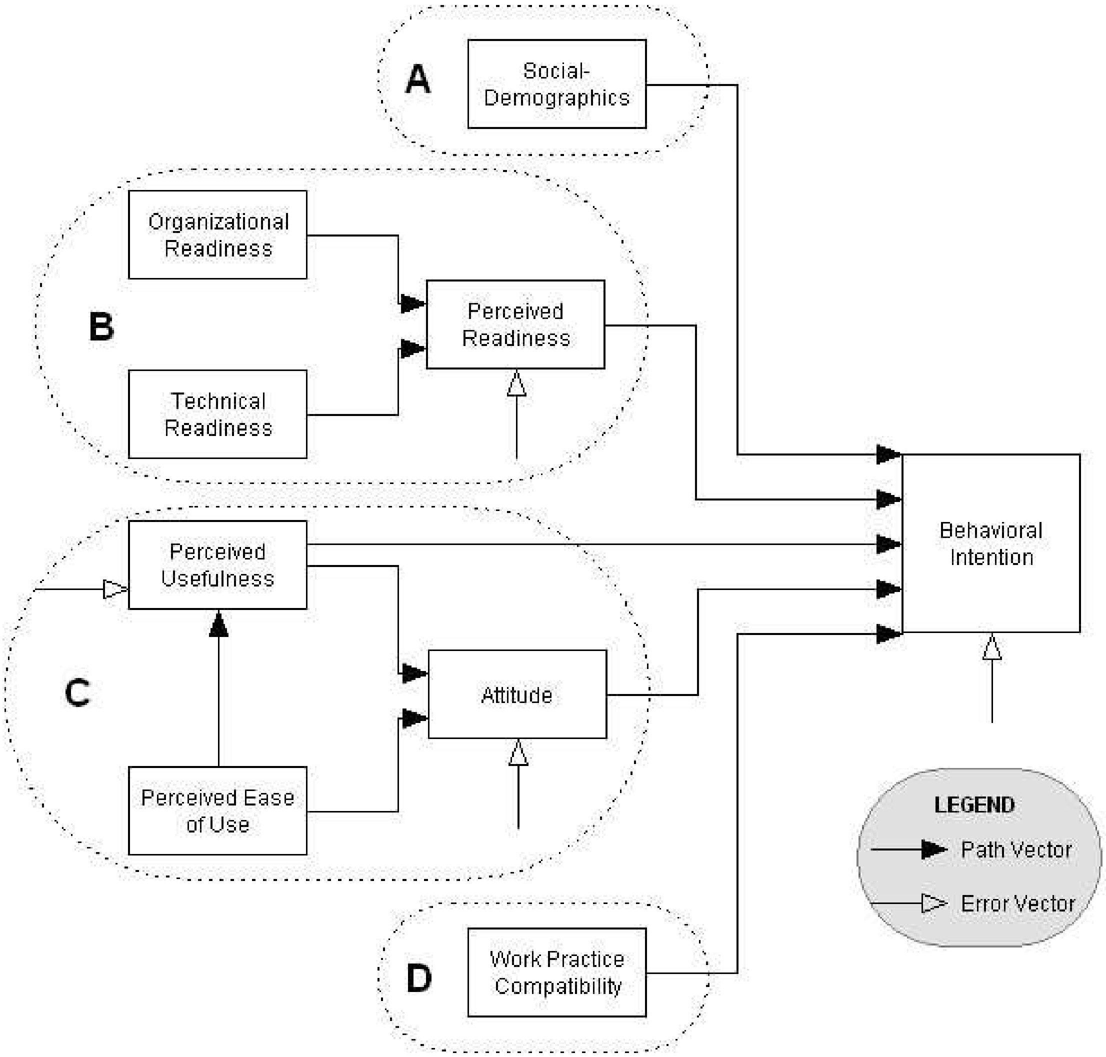

Figure 1 – Proposed Research Model

Research Questions

Drawing upon this research model, the study was guided by the following research questions:

1. To what extent is physician behavioral intent to use online disability evaluation systems influenced by social demographic, readiness, attitudinal, and work practice compatibility factors?

2. To what extent is physician behavioral intent to use online disability evaluation systems influenced by the overall "fit" between new innovation and the technical readiness of current practices?

Research Methodology

To address these research questions, this study analyzed data from a nationwide survey of physicians. This survey was conducted by the authors drawing upon a nationwide network of physician providers made available by a private sector company that was developing a new online disability evaluation system. From an overall population of 10,000 physicians, a survey was sent to 278 representing a stratified sample of active disability providers chosen from a population of 500 disability evaluation providers who met a minimum threshold in terms of their activity in disability evaluations (at least 25 evaluations per year). It is important to note that the 500-physician population did not include the top 40 providers in terms of total evaluation conducted. This exclusion was made in consultation with the private sector company; the rationale being that: 1) the top providers had a very strong economic reason to report favorably on the system, as their level of economic participation with the company was substantial, and 2) several of these top providers had been already exposed to the online system in a testing environment. In this sense, the sample represented the most likely next tier of online system users (The implications of this sample selection are addressed in the discussion section). A total of 144 surveys were received, with 141 valid questionnaires, representing a return rate of 52%.

The survey instrument contained 36 items on a three-page survey. This instrument contained various question types such as check-off, fill-in, and a 5-point Likert-scale with anchors at strongly agree and strongly disagree or, at extremely important and not important. For the constructs Work Process Compatibility and Social-Demographic Factors, open-ended or multiple-choice questions were used. The questions were selected for their theoretical importance as well as their potential relevance to practice after a series of meetings with the company.

FINDINGS

Descriptive Statistics

Among the 141 responses, 60% of the respondents were between 40 to 60 years old; 77% were male and 23% were female, both representing various specialties. A majority (82.5%) of the physicians said that they use computers more than several times a week. Among the respondents of the survey, 69% of the practices have less than 10 staff members. Only 17% reported that they have more than 10 staff members working in the practice. In their practice, 67.4% of the physicians use an Internet browser, 75.4% use office applications while 11% did not have an Internet connection at their practice.

The general pattern of descriptive findings suggests a group that is relatively accepting of technology (see Figure 2). While 78.5% of the physicians believe that computers make their job easier, interestingly, 60.3% of the physicians believed that it takes a lot of time to find information on the Internet. In terms of the new disability online system, 67.4% believed that they would have enough technology resources and skills to use the new online system. 59.3% of the physicians said that they would use the new online system to file all reports, and 19.5% reported that they would partially use it. A similar majority (58.9%) of the physicians said that they would use the new online system directly, i.e. they would personally prepare the online report either during or after the evaluation, and 25.6% said that they would use the new system indirectly, i.e. they would prepare the report on paper and the administrative staff will enter the data online. This compares to a reported current (offline) practice where 57.4% of the physicians often dictate reports to transcription services, 14.2% of the physicians often prepare report by themselves and the administrative staff types and enters, and 24% of the physicians often type their own reports.

	Percentage	N
Physicians use computer systems at least several times a week.	82.	12
Physicians agree that computer systems make their job easier.	78.	13
It takes me a lot of time to find information on the Internet.	60.	13
We will have enough technology resources to use the system.	67.	13
We will use the online system to use all reports.	59.	11
We will use the online system directly.	58.	13
We will use the online system indirectly.	25.	13

Figure 2 – Selected Descriptive Results

In terms of multivariate analyses, there were three dependent variables of interest. The first was the measure of how often they would use the new online system. The second variable was the measure of their intention to use the new system directly, and the third was a measure of their intention to use the new system indirectly. Pearson product moment correlations for the key variables are presented in Figure 3.

		How often you will use the new system?	Physician enter data indirectly	Physician enter data directly
A	Ag	-0.17	0.02	-.233(*)
B	How often do you use computer sys?	.545(**	0.00	.429(**
	Use of office applications (MS office, lotus)	.423(**	-	.273(**
	Use of internet browsers	.308(**	-	.260(**
C	Computer systems make it easier to do my job	.322(**	0.00	0.13
	Conducting the exam is easier	.380(**	.172(*	.211(*
	Report review is easier	.522(**	0.04	.284(**
	Report submission is electronic and secure	.567(**	0.07	.366(**
	Report preparation is easier	.511(**	-	.501(**
	Report preparation before the exam is easier	.332(**	0.12	.263(**
	Finding information on the Internet takes time	.299(**	-	.411(**
D	Physician dictates reports to transcription services	-.253(*)	-	-.209(*)
	Physician types own report	.327(*	-	.362(**
	Physician prepares report and administrative staff types	0.00	.464(**	-

Figure 3 – Results of Correlations

At the bivariate level, there are significant correlations with several of the key attitudinal, readiness, and compatibility factors (that is, all classes except social-demographics have significant bivariate correlations). These relationships were often quite strong; for example there was a strong correlation (r = .522; sig. = .01) between the belief that the new system would make report reviewing easier and intention to use the new system frequently. For the behavioral intention measurement of physicians entering data directly, significant positive correlations exist for frequency of computer use and the belief that it takes a lot of time to find information on the Internet. This finding is somewhat counter-intuitive; there is a positive correlation between agreement with this statement and behavior intention to use the new online system. While the attitudinal item "It takes me a lot of time to find information I need on the Internet" was originally construed to be a measure of general technology attitude (agreeing with the statement suggested a negative attitude), these findings raise questions as to construct validity. It might be as much a measure of experience for example, with more experienced users having a realistic assessment of the time it can take to find items.). Use of office applications and ease of report generation were significantly correlated with two behavioral intent measurements, namely, direct physician data input and how often physician will use the system. Significant positive correlations exist between physician typing own report and physician entering the data directly, and conversely, significantly negative correlations exist between physician using staff to type the report and the physician entering the data directly.

Multivariate Data Analysis

In order to analyze the variables that contributed significantly to physician intentions to use the new online system, three stepwise multiple regressions were performed. The variables were organized into three categories that traditional technology acceptance theories indicate are highly predictive of behavioral intent, namely, A) Social-Demographic, B) Organizational/Technical Readiness, C) Attitude (see Figure 1). A fourth category was added, D) Work Practice Compatibility, to analyze the predictive nature of physicians' technologically-ready work environment and the nature of the task-technology fit on physicians' intention to use the system. As noted above, behavioral intent was measured by assessing how often physicians would be willing to use the new system and if they were willing to use it, whether that would use it directly or indirectly. Figures 4, 5, and 6 illustrate these relationships.

The stepwise regression for predicting how often physicians would be willing to use the new online system produced a model with an $R^2 = 0.447$, which demonstrates that the five independent variables accounted for 44.7% of the dependent variable (Figure 4). Of the five variables, two were members of the Organizational/Technical readiness category and three were part of the Attitude category. The most significant predictor for this variable was the physicians' belief that the new online disability evaluation system was a good idea (Beta = .226, sig t = .004). Additionally, variables that measured physicians' belief that additional feature are useful (Beta = .214, sig t = .007) and physicians' frequency of computer use (Beta = .202, sig t = .005) were also significant predictors of the behavioral intent to use the online disability system.

How often would physician use the new online system?	R^2	Adj.R^2	F	Sig.
	0.46	0.44	23.60	0.00
Variables	**Construct**	**Bet**	**T**	**Sig.**
Use of Office applications	B	0.17	2.49	0.01
Frequency of computer use	B	0.20	2.88	0.00
Actual experience of using new system will be difficult	C	0.18	2.60	0.01
Additional features are useful	C	0.21	2.76	0.00
New system is a good	C	0.22	2.93	0.00

Figure 4 – Stepwise Multiple Regressions

In terms of a physician's intention to directly use the new online system (Direct), seven variables entered the regression equation (Figure 5). Of these seven variables, one was in the Organizational/Technical Readiness category, four were in the Attitude category and two were in the Work Practice Compatibility category. The R^2 was 0.439, which demonstrates that the independent variables accounted for 43.9% of the dependent variable. The most significant predictor of Behavioral Intent (Direct) was the "belief that preparing for the exam is easy" (Beta = .284, sig t < .001). This was followed by, "physician uses staff to type report" (Beta = -.270, sig t < .001). Other significant predictors include the "belief that computers make their job easier" (Beta = -.265, sig t = .001), frequency of computer use (Beta = .250, sig t = .001), and the "belief that it takes a lot of time to find information on the Internet" (Beta = .243, sig t = .001).

Physician enters data (Direct)	R^2	Adj. R^2	F	Sig.
	0.46	0.43	16.63	0.00
Variables	Construct	Bet	T	Sig.
Frequency of computer use	B	0.25	3.36	0.00
Using new system is beneficial for my practice	C	0.16	2.17	0.03
Finding Infor in the Internet takes time	C	0.24	3.36	0.00
Computers make my job easier	C	-	-	0.00
Preparing exam is easy	C	0.28	3.88	0.00
Physician types own	D	0.18	2.81	0.00
Physician uses staff to type report	D	-	-	0.00

Figure 5 – Stepwise Multiple Regressions

For physicians who indicated that they would not enter the data themselves (Indirect), five variables entered the regression equation (Figure 6). Of these five variables, two were members of the Attitude category and three were in the Work Practice Compatibility category. The R^2 was 0.243, which demonstrates that the independent variables accounted for 24.3 % of the dependent variable. The most significant predictor of Behavioral Intent (Indirect) was "physician uses staff to type report" (Beta = .324, sig t < .001). Two other significant predictors included "physician types own report" (Beta = -.284, sig t = .001) and the "belief that it takes a lot of time to find information on the Internet" (Beta = -.239, sig t = .002).

Physician uses administrative staff to enter data (Indirect)	R^2	Adj.R^2	F	Sig.
	0.27	0.24	9.97	0.00
Variables	Construct	Bet	T	Sig.
Conducting exam is easier	C	0.20	2.69	0.00
Finding info in the Internet takes time	C	-	-	0.00
Physician uses transcription service	D	-	-	0.02
Physician types own	D	-	-	0.00
Physician uses staff to type report	D	0.32	4.29	0.00

Figure 6 – Stepwise Multiple Regressions

Path Analysis

The results of path analysis with dependent variable Behavioral Intent for Direct/Indirect Use and Behavioral Intent of Use Frequency are reported next. Upon completion of stepwise multiple regressions and bivariate correlation analysis, the estimated model indicates that work practice compatibility has significant direct effects on predicting the way physicians will use the new system. While predicting Use Frequency, Attitude and Perceived Usefulness are the only two variables that have significant direct effects. This signifies that physicians' frequency-of-use predictions are based on the usefulness of the system and their attitude towards the system. However, the decision regarding how they will integrate the new system into their practice can be predicted by the work practice compatibility variable. Social Demographics and Perceived Readiness variables did not have any direct effect on behavioral intent.

Behavioral Intent for Direct/Indirect Use

The analysis of the data revealed that the only significant variable for predicting INDIRECT use was work practice compatibility. Figure 7 presents the estimated path model. Table 1 illustrates significant predictors of INDIRECT use with the corresponding error vector. The results of the estimated model indicate that work practice compatibility variables were good predictors of physician acceptance as measured by intent to use the new online system indirectly. The single error vector was between .85 and .95, indicating a moderate causal relationship. The path coefficients and error vectors for the estimated model are given in Figure 7.

Table 1 – Prediction of Physicians Indirect use of online system

Independent Variables	Beta	t	Sig t
WPC13c – Physician prepares reports and administrative staff types and enters.	.358	4.584	<.001
WPC13b – Physician types their own report	-.253	-3.249	.001

R = .414
R^2 = .171
Adj. R^2 = .159

$$E = \sqrt{1 - R^2} = .896$$

The decomposition table for bivariate covariation is given in Table 2. Analysis of the decomposition table reveals that all non causal values (< 0.05) showed a good relationship between the model prediction and correlation. Thus, it appears that the expected and observed outcomes are virtually the same for 100% of the relationships.

Table 2 – Decomposition Table for Q33 INDIRECT Use

	33I/13c	**33I/13b**
Original Covariation	0.33	-0.21
Direct Effects	0.36	-0.25
Indirect Effects	0.00	0.00
Total Effects	0.36	-0.25
Non causal	-0.03	0.04

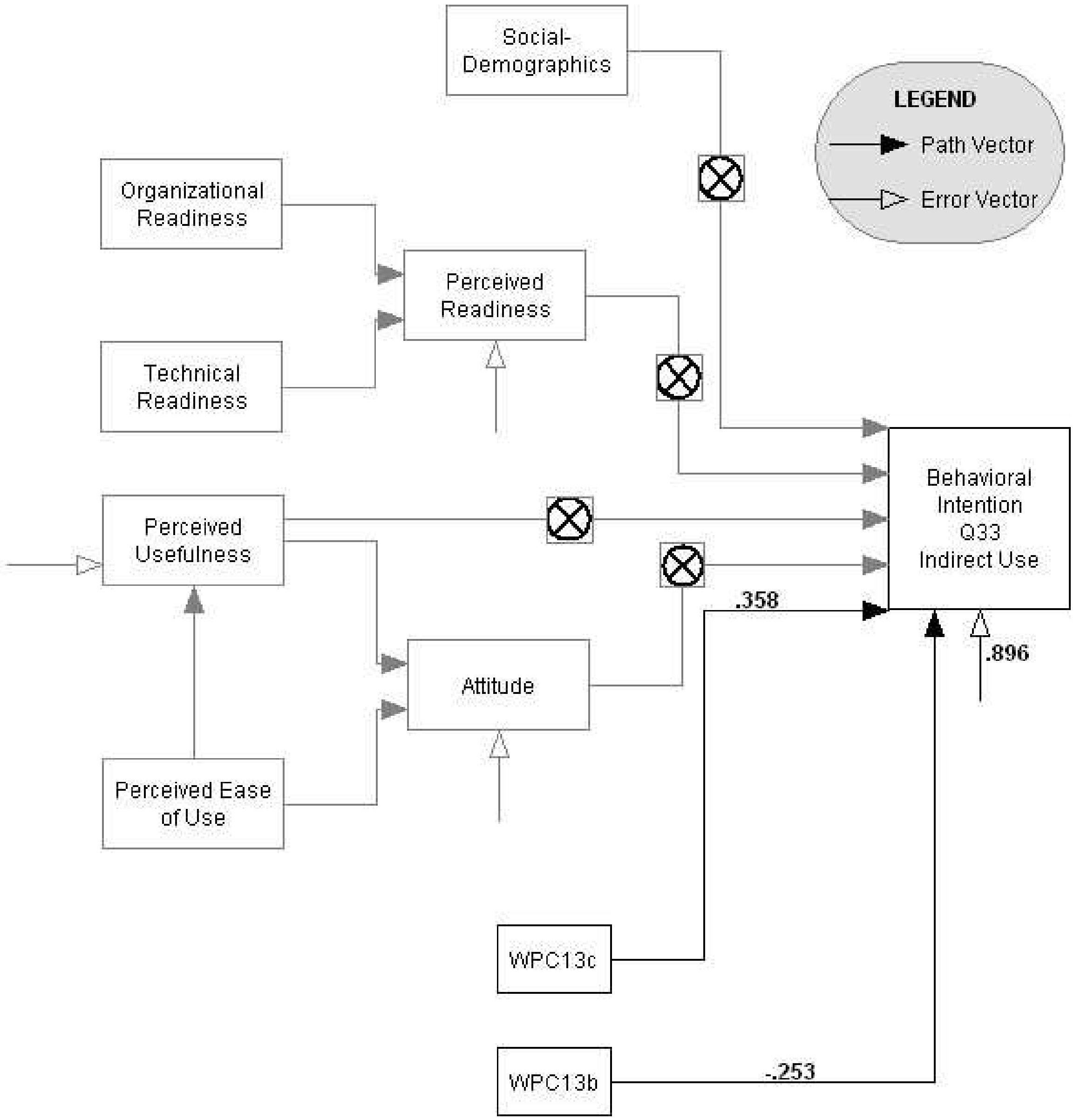

Figure 7 – Estimated Path Model for Q33 Indirect Use

Behavioral Intent of Use Frequency

The analysis of the data revealed that the significant variables for predicting the frequency of use were perceived usefulness and attitude where as work practice compatibility variable did not stay in the regression equation. This indicates that the frequency of use is driven by the usefulness of the system and user attitude towards the system rather than the work practice compatibility variables. Table 3 illustrates significant predictors of frequency of use. Tables 4-7 illustrate the remaining significant predictors of the other variables that remained in the regression equation.

Table 3 – Prediction of Physician's frequency of use of online system

Independent Variables	Beta	t	Sig t
PU29 – The online system would allow you to generate a narrative report with minimal keystrokes.	.303	4.269	<.001
A24 – This online evaluation system is a good idea.	.305	4.042	.001
A25 – I would find the actual experience of using this online system difficult.	.252	3.520	<.001

R = .640
R^2 = .409
Adj. R^2 = .396

Table 4 – Prediction of PEOU and PU for A25

Independent Variables	Beta	t	Sig t
PU32 – The online system would allow you to customize a report.	.201	2.615	.010
PEOU17 – I find it easy to learn how to use new software applications.	.209	2.731	.007
PU15 – Computer systems do not help me to save time.	.359	4.861	<.001

R = .556
R^2 = .309
Adj. R^2 = .294

Table 5 – Prediction of PEOU and PU for A24

Independent Variables	Beta	t	Sig t
PEOU17 – I find it easy to learn how to use new software applications.	.209	2.600	.010
PU31 – The online system would allow you to electronically submit the completed report in a secure manner instead of faxing.	.378	5.414	<.001
PU16 – Computer systems make it easier to do my job.	.256	3.056	.003

R = .647
R^2 = .419
Adj. R^2 = .406

Table 6 – Prediction of PEUO for PU15

Independent Variables	Beta	t	Sig t
PEOU18 – It takes me a lot of time to find information I need on the Internet.	.429	5.597	<.001
R = .429 R^2 = .184 Adj. R^2 = .178			

Table 7 – Prediction of PEUO for PU16

Independent Variables	Beta	t	Sig t
PEOU18 – It takes me a lot of time to find information I need on the Internet.	.154	1.996	.048
PEOU17 – I find it easy to learn how to use new software applications.	.513	6.644	<.001
R = .601 R^2 = .362 Adj. R^2 = .352			

The calculations of the error vectors are presented in Table 8. The path coefficients and error vectors for the estimated model are given in Figure 8. The decomposition table for bivariate covariation is given in Table 9.

Table 8 – Calculation of Error Vectors

Endogenous Variable	R	R^2	$e = \sqrt{1 - R^2}$
Q34-Frequency of use	.640	.409	.769
A24 – This online evaluation system is a good idea.	.647	.419	.762
A25 – I would find the actual experience of using this online system difficult.	.556	.309	.831
PU15 – Computer systems do not help me to save time.	.429	.184	.903
PU16 – Computer systems make it easier to do my job.	.601	.362	.799
PU29 – The online system would allow you to generate a narrative report with minimal keystrokes.	.260	.068	.965

PU31 – The online system would allow you to electronically submit the completed report in a secure manner instead of faxing.	.224	.050	.975
PU32 – The online system would allow you to customize a report.	.351	.123	.936

Table 9 – Decomposition Table for Q34 Frequency of use

	34/29	34/24	34/25	29/18	24/16	24/31	24/17	25/15
Original Covariation	0.47	0.52	0.43	0.26	0.51	0.52	0.44	0.45
Direct Effects	0.30	0.31	0.25	0.26	0.26	0.38	0.21	0.36
Indirect Effects	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00
Total Effects	0.30	0.31	0.25	0.26	0.26	0.38	0.43	0.36
Non causal	0.17	0.21	0.18	0.00	0.26	0.14	0.02	0.09

	25/32	25/17	16/18	16/17	31/17	15/18	32/17
Original Covariation	0.36	0.36	0.40	0.59	0.22	0.43	0.35
Direct Effects	0.20	0.21	0.15	0.51	0.22	0.43	0.35
Indirect Effects	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Total Effects	0.20	0.28	0.15	0.51	0.22	0.43	0.35
Non causal	0.16	0.08	0.24	0.07	0.00	0.00	0.00

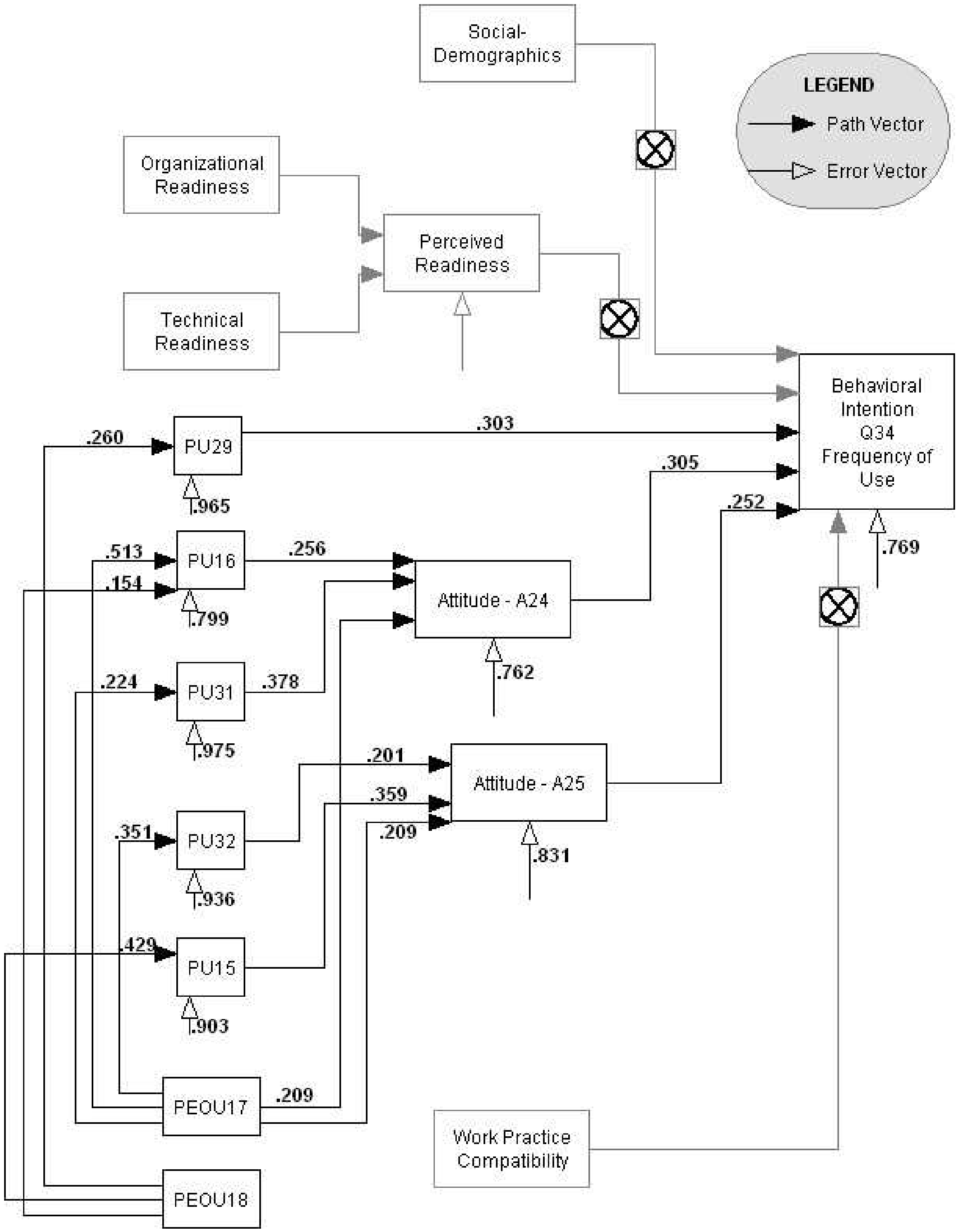

Figure 8 – Estimated Path Model for Q34 Frequency of Use

The results of the estimated model indicate that eight variables are moderate to good predictors of physician acceptance as measured by the frequency of intended use of the new online system. Two of the eight error vectors (PU29 and PU31) were higher than .95, indicating a weak causal relation, and two of the remaining six error vectors (PU32 and PU15) were between 0.85 and 0.95, indicating a moderate causal relationship. The error vectors for the variables of Q34 (.769), A24 (0.762), A25 (.831), and PU16 (0.799) were all less than .85 indicating a good relationship. The R^2 value of 0.409 (Q34), 0.419 (A24), 0.309 (A25), and 0.362 (PU16) indicate a strong relationship, accounting for 40.9%, 41.9%, 30.9%, and 36.2% respectively of the variation in the dependent variable. The other R^2 values of 0.068 (PU29), 0.050 (PU31), 0.123 (PU32), and 0.184(PU15) indicate a weak to moderate relationship.

Analysis of the decomposition table reveals that seven of the non causal values out of fifteen were more than 0.10 indicating a difference between what the model predicts and what the correlation describes. Five non causal values (< 0.05) showed a good relationship between the model prediction and correlation. Three non causal values (between 0.05 and 0.10) showed a moderate relationship between the model prediction and correlation. Thus it appears that the expected and observed outcomes are virtually the same for about 53% of the relationships.

DISCUSSION

All levels of analyses reveal a pattern of support for the notion that behavioral intent of the physician to use the new online system is a function of several attitudinal, organizational, technical, and work system factors. When behavioral intent was measured on a general basis (how often the physician would be willing to use the new online system), the physicians' organizational and technical readiness (Construct B) as well as specific attitudinal measures toward the online system (Construct C) were more significant in predicting physicians' behavioral intent to use the system than social-demographic or work practice compatibility measures (Constructs A and D respectively). When physicians' behavioral intent to use the system was measured in terms of interaction (whether they would directly input the information in the system or whether they would delegate this responsibility to a staff member), specific attitudinal measures toward the online system (Construct C) and work practice compatibility measures (Construct D) were significant in predicting their behavioral intent.

Organizational and technical readiness of the physicians' work environment (Construct B) again was significant, but only for physicians directly inputting information into the new online system. Thus, it appears that as the physician considered discrete activities pertaining to the new system, these responses were less associated with more global attitudes regarding technology. This demonstrates the fact that when individual behavioral intent is assessed (i.e., physicians are queried about interacting with the system either directly or indirectly), work practice compatibility issues play a more significant role in predicting behavioral intent than do the measurements that support traditional theories of technology acceptance. Moreover, the more technologically ready a physician's current practice was (work practice compatibility) the more likely they were to use the system. In two of the three behavioral intent measurements, the constructs from traditional theories of technology acceptance were not as predictive of behavioral intent as were the constructs for technical readiness and work practice compatibility. The results of the path analysis also suggest that work system compatibility is important for a detailed understanding of online system usage[2].

These observations present an interesting challenge to the TAM and TPB models, which state that general attitudes towards a system's perceived usefulness, ease of use, behavioral control, and subjective norms were the primary predictors of behavioral intent. Whereas these two models identify variables contributing to individual variables that effect behavioral intent, they do not consider organizational work system readiness as having a high level of predictive power of behavioral intent. This supports the notion that overall "fit" is important; that is, technology acceptance can be seen not as an isolated event, but as something that represents one step in the continuum of physicians' work processes and decision-making processes.

Looking more broadly, it is recognized that these patterns are suggestive of a very complex socio-technical phenomena, and that there is much still to be done in terms of a comprehensive predictive model of physician adoption of technology (Spil et al., 2002). Analysis of the data from this research provides promising empirical support for Spil (Spil et al., 2002) and Pare and Elam's (Pare & Elam, 1999) claim that physician resistance to technology is not merely a factor of behavioral attitudes towards technology based simply on how useful and easy the system is to use. Rather, it is based on complex social attitudes and norms that are challenged when new technology is introduced into the workplace (Spil et al., 2002). Thus future research is needed to provide a deeper

[2] Implications of the path analysis for extending TAM/TPB in medical informatics are discussed in (Horan, Tulu, & Hilton, 2004).

understanding of the nature of physician use of technology by analyzing these complex social attitudes as they relate to technology acceptance and use.

Implications in Research

The field of medical informatics is moving away from the simplistic notion of physician acceptance or resistance, toward a more nuanced understanding of the factors surrounding relative acceptance or resistance (Pare & Elam, 1999; Schuring & Spil, 2002; Spil et al., 2002; Succi & Walter, 1999). This study examined one particular form of physician online use: disability assessment. The results provided above are promising for several reasons. First, they suggest that physician acceptance is a function of several factors, which include the organizational and technical readiness of the current work system environment within which physicians operate. A next step for research would be to conduct confirmatory analysis in related relatively unstructured clinical disability treatment settings to better understand how attitudinal, organizational, and work system factors operate in these various milieus.

A second path for future research emanates from the design limitation of current research models. Most significantly, the survey assessed behavioral intent to engage in online disability evaluation. The phenomenon of behavior intent can be useful in determining inclinations toward a new technology. However, in order to truly understand the relative influence of the factors of interest in physician behavior with online systems, one must ultimately focus on adoption behavior. Secondly, the sample for the current research focused on an active stratum of users of these systems (see methods section, including footnote on sample selection). The next step in this analysis would be to conduct a comparative assessment of this group, vis-à-vis other strata. It would be interesting to uncover the extent to which the various factors apply up and down the spectrum. For example, for very frequent disability evaluators, it would be interesting to understand whether there is any predictive power attributable to traditional TAM factors, given the strong economic ties to the system. On the other end of the spectrum, it would be interesting to understand which factors (or combinations thereof) explain why certain physician practices do not cross the threshold to become active users of the system.

In the area of work-practice considerations, future research could explore further how the inherent nature of physicians' decision-making tasks, such as disease diagnosis and treatment, could be supported with technology. As evidenced by this research, physicians who already function in a highly technologically ready work environment are more likely to use technology than those who do not. Further exploration into the effects of technologically ready work practices on physician decision-making would advance knowledge in the quest for a better understanding of physician acceptance of technology in the clinical setting. Moreover, continued research in the area of Task-Technology Fit could explore how different levels of technology can provide greater support for various medical tasks that would be necessary to further understand physician acceptance of technology in clinical practice settings.

Implications in Practice

While the principle objective of this study has been to explore and understand those factors associated with physician acceptance of online systems, the findings do suggest a number of practical considerations. First, there is a need to take a holistic approach to deploying new online systems, in contrast to an approach that would focus, for example on affecting the overall attitude of physicians about new systems. Part of this holistic approach would include, 1) insuring technological and organizational readiness, 2) staff readiness and training for implementing and using the system, and 3) physician orientation to the benefits of information systems to their practice.

An additional implication of the findings deals with the type of outreach and training that might be effective on creating online use among physicians. The findings from this research suggest, for example, that general marketing efforts to change attitudes toward online use would be ineffective at best. Rather, outreach should focus holistically on providing an inventory of the "readiness" of the candidate office to conduct online examinations. "Readiness assessment" could include a technical "work-systems" assessment as well as a physician and (key) staff orientation to the specific dimensions of the system. This is but one example of how research from medical informatics can inform the migration of practices from offline to online.

Possibilities for Advanced Practices Laboratory

An underlying theme of the findings is that medical informatics systems need to be assessed within the context (e.g work system) of their use. This theme has its roots in the foundation papers included in this volume (Davis, 1989; DeLone & McLean, 1992;

Kaplan et al., 2001), and by the approaches that have driven the design of this research (e.g. TAM, TPB, TTF). However, the findings of this research and related research serve to underscore the importance of assessing the use of medical informatics systems within the precise context of their use, including how this use evolves over time. In other words, research needs to address how the technologies are situated in the organization and dynamic learning that may occur within the organization (Brown & Duguid, 1991).

One method would be to establish an advanced practices partnership with medical informatics organizations. Such a "living lab" would facilitate a longitudinal context-rich approach to assessing adoption, use and organizational responses to online medical informatics systems. The objectives of this laboratory would be to establish a network of physicians to test innovative technological solutions within their work context, assess the use of technological solutions within specific medical informatics domains, facilitate the deployment of technological solutions among physicians, and provide research and training opportunities for researchers and practitioners. Consequently, this "living lab" would provide a nationwide network and laboratory environment for the testing, training and deployment of innovative technological solutions to improve various processes in the medical informatics field.

CONCLUSION

Medical informatics continues to grow as an important source of productivity improvements in the medical arena. Yet, physician acceptance remains an oft cited barrier to new clinical informatics systems (V.L. Patel & Kaufman, 1998). This research has helped to establish a context-based approach to understanding factors that influence physicians' behavioral intent, as well as ultimate behavior. Such factors include the setting in which the physician works, the type of work practice in which they are engaged, as well as the perceptions regarding the value of specific informatics systems. This research effort has shown that physicians who currently operate in technologically ready medical practices are more likely to use new information systems in their practices than physicians who rely primarily on non-automated work systems.

Multivariate data analysis of variables affecting physicians intention to use new systems assisted in understanding the value of the integrated research model, but the greater value of this research is the notion that technology adoption efforts need to attend to other factors surrounding the physician work system practices and work behavior, not just the general attitude that a physician has regarding information systems. This includes possible efforts to better equip medical settings, to introduce intermediate computer-related work systems, and to emphasize potential benefits of specific systems. Thus, the individual variables of the current technology acceptance models such as TAM, TPB, and TTF need to be expanded to include constructs that capture work system practices and work system compatibility in order to provide a more precise picture of the factors that affect a user’s intention to use a new technology.

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References

Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice Hall.

Bomba, D. (1998). A Comparative Study of Computerized Medical Records Usage Among General Practitioners in Australia and Sweden. *MedInformation, 9*, 55-59.

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. *Organization Science, 2*(1), 40-57.

Chau, P. Y. K., & Hu, P. J. H. (2001). Information Technology Acceptance by Individual Professionals: A Model Comparison Approach. *Decision Sciences, 32*(4).

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly, 13*(3 (September)), 319-340.

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research, 3*(1), 60-95.

Demeter, S. L., Andersson, G. B. J., & Smith, G. N. (1996). *Disability Evaluation*. St.Louis: Mosby-Year Book, Inc.

Dishaw, M. T. (1999). Extending the Technology Acceptance Model with Task-Technology Fit Constructs. *Information & Management, 36*(1), 9-22.

Godin, G., & Kok, G. (1996). The Theory of Planned Behavior: A Review of Its Applications to Health-Related Behaviors. *American Journal of Health Promotion, 11*(2), 87-98.

Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly, 19*(2).

Greatbatch, F., Heath, C., Campion, P., & Luff, P. (1995). How Do Desktop Computers Affect the Doctor-Patient Interaction? *Family Practice, 12*, 32-35.

Horan, T. A., Tulu, B., & Hilton, B. (2004). Extending Technology Acceptance to Incorporate Task-Technology Fit: The Case of Physician Acceptance of Online Systems. *Working Paper, Under Review*.

Horan, T. A., Tulu, B., Hilton, B., & Burton, J. (2004, 5-8 January). *Use of Online Systems in Clinical Medical Assessments: An Analysis of Physician Acceptance of Online Disability Evaluation Systems.* Paper presented at the 37th Annual Hawaii International Conference on System Sciences, Hawaii.

Johnston, J. M., Leung, G. M., Wong, J. F. K., Ho, L. M., & Fielding, R. (2001). Physicians' Attitudes Towards the Computerization of Clinical Practice in Hong Kong: A Population Study. *International Journal of Medical Informatics, 65*, 41-49.

Kaplan, B. (1997). Addressing Organizational Issues Into the Evaluation of Medical Systems. *Journal of the American Medical Informatics Association, 4*(2), 94-101.

Kaplan, B., Brennan, P. F., Dowling, A. F., Friedman, C. P., & Peel, V. (2001). Toward an Informatics Research Agenda. *Journal of the American Medical Informatics Association, 8*(3), 235-241.

Kwon, S. K., & Chidambaram, L. (2000). *A Test of the Technology Acceptance Model: The Case of Cellular Telephone Adoption.* Paper presented at the 33rd Hawaii International Conference on Systems Sciences, Hawaii.

Leung, G. M., Johnston, J. M., Ho L., Wong, F., & Cameo, S. C. (2001). Computerization of Clinical Practice in Hong Kong. *International Journal of Medical Informatics, 62*, 143-154.

Lucas, H. J., Walton, E. J., & Ginzberg, M. J. (1988). Implementing Packaged Software. *MIS Quarterly, 12*(4), 537-549.

Mathieson, K., Peacock, E., & Chin, W. W. (2001). Extending the Technology Acceptance Model: The Influence of Perceives User Resources. *The DATA BASE for Advences in Information Systems, 32*(3), 86-112.

McKinlay, J. B., Potter, D. A., & Feldman, H. A. (1996). Non-Medical Influences on Medical Decision-Making. *Social Science Medicine, 42*(5), 769-776.

Mikulich, V. J., Liu, Y. A., Steinfeldt, J., & Schriger, D. L. (2001). Implementation of Clinical Guidelines Through an Electronic Medical Record: Physician Usage, Satisfaction and Assessment. *International Journal of Medical Informatics, 63*(3), 169-178.

Mitchell, E., & Sullivan, F. (2001). A Descriptive Feast But An Evaluative Famine: Systematic Review of Published Articles On Primary Care Computing During 1980-1997. *British Medical Journal, 322*, 279-282.

Nielsen, A. R. P. L. (1998). *A Study Into Levels Of, and Attitudes Towards Information Technology in General Practice* (Vol. 1 & 2). Sydney, Australia.

Pare, G., & Elam, J. J. (1999). Physicians’ acceptance of clinical information systems: an empirical look at attitudes expectations and skills. *International journal of Healthcare Technology and Management, 1*(1), 46-61.

Patel, V. L., Arocha, J. F., & Kaufman, D. R. (2001). A Primer on Aspects of Cognition for Medical Informatics. *Journal of the American Medical Informatics Association, 8*(4), 324-343.

Patel, V. L., & Kaufman, D. R. (1998). Medical Informatics and the Science of Cognition. *Journal of the American Medical Informatics Association, 5*, 493-502.

Ridderikhoff, J., & Van Herk, B. (2000). Who is Afraid of the System? Doctors' Attitude Towards Diagnostic Systems. *International Journal of Medical Informatics, 53*, 91-100.

Ridsdale, L., & Hudd, S. (1994). Computers In the Consultation: The Patient's View. *British Journal of General Practice, 44*, 367-369.

Ryan, G. W. (1998). What Do Sequential Behavior Patterns Suggest About the Medical Decision-Making Process? *Social Science Medicine, 46*(2), 209-225.

Schuring, R. W., & Spil, T. A. M. (2002). *Assessing Relevance and micro-relevance to the profesional's working process as a determinant of IT-diffusion and IT-use in healthcare.* Paper presented at the International Information Resource Management Association Conference, Seattle, USA.

Spil, T. A. M., Schuring, R. W., & Katsma, C. (2002, 15-16 July). *Assessing Resistance of professionals as a determinant of IT-diffusion and IT-use in healthcare.* Paper presented at the 9th European Conference on IT Evaluation (ECITE 2002), Paris, France.

Succi, M. J., & Walter, Z. D. (1999). *Theory of User Acceptance of Information Technologies: An Examination of Health Care Professinals.* Paper presented at the The 32nd Hawaii International Conference on System Sciences, Hawaii, USA.

Thakurdas, P., Coster, G., Curr, E., & Arroll, B. (1996). New Zealand General Practice Computerization: Attitudes and Reported Behavior. *New Zealand Medical Journal, 106*, 419-422.

Tulu, B., Hilton, B., & Horan, T. (2003). *Physicians Acceptance of Web-based Medical Assessment Systems: Findings From a National Survey.* Paper presented at the Americas Conference on Information Systems, Tampa, Florida, USA.

Westberg, E. E., & Miller, R. A. (1999). The Basis for Using the Internet to Support Information Needs of Primary Care. *Journal of the American Medical informatics Association, 6*(1), 6-25.

Zigurs, I., Buckland, B. K., Connolly, J. R., & Wilson, E. V. (1999). A Test of Task-Technology Fit Theory for Group Support Systems, Database for Advances in Information Systems. *Summer, 30*(3/4), 34-51.