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Protection Motivation Theory, Task-Technology Fit and the Adoption of Personal Health Records by Chronic Care Patients: The Role of Educational Interventions

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ABSTRACT

With the increasing prevalence of chronic disease throughout the world, Personal Health Records (PHRs) have been suggested as a way to improve chronic disease self-management. However, PHRs are not yet widely used by consumers. Protection Motivation Theory (PMT) has been successfully utilized to explain health related behaviors among chronic care patients. In addition, several Information Systems (IS) theories have been successfully used to explain technology adoption. This study combines PMT with IS theory to propose a research model to aid in the understanding of PHR adoption by chronic care patients. The role of educational interventions on various elements of the proposed model is also examined. We outline a survey-based study to empirically validate the proposed model using structural equation modeling techniques.

Keywords

Personal Health Records (PHR), Protection Motivation Theory (PMT), Task-Technology Fit (TTF), Educational Interventions, Self-Management, Chronic Disease

INTRODUCTION

The World Health Organization's (WHO) published statistics on chronic disease (World Health Organization, 2005) reveal staggering effects on both morbidity and economic costs. For chronic diseases, such as Type 2 diabetes, "self-management practices have substantial consequences on morbidity and mortality" (Heisler, et al., 2002, p. 243). Electronic Personal Health Records (for the remainder of this paper, termed PHR), a form of Consumer Health Information Technology (C-HIT) have been proposed as a way to assist chronic disease patients in self-managing their disease (Assadi & Hassanein, 2009; Tang, et al., 2006). While all patients can potentially benefit from the adoption of PHRs, those patients with chronic conditions can potentially achieve greater benefits, due to the increased need to access their health related information on a regular basis and the requirement to actively self-manage their disease in a joint effort with physicians and other caregivers (Pope, et al., 2006). While the existence of PHRs appears to be understood by patients and physicians, adoption of PHRs has been an issue (Assadi & Hassanein, 2009). Technologies such as C-HITs have been shown to help self-management, however, they can only do so if they are adopted (Or & Karsh, 2009), thus "system developers and those who implement the systems should pay attention to the underlying reasons and motives for patient acceptance of the [C-HIT] technology" (Or & Karsh, 2009, p. 556).

Protection Motivation Theory (PMT) has been used for decades to analyze and predict health related behaviors (Norman, et al., 2005), with meta-analyses (Floyd, et al., 2000; Milne, et al., 2000) showing PMT variables as good predictors of health related behaviors and behavioral intention in general. PMT is therefore very appropriate to the health behavior context of our research study. At the same time, IS theories such as Task-Technology Fit (TTF) have successfully shown the relationships among the variables that can predict consumers' behaviors towards technology (Goodhue, 1995). To date however, a limited number of studies have combined PMT with IS theory. Additionally, TTF in combination with the Technology Acceptance Model (TAM) have been previously shown to provide greater explanatory power than either model alone (Dishaw & Strong, 1999; Klopping & McKinney, 2004). However, we have chosen to combine TTF with PMT, as PMT constructs encompass the most salient items from TAM (i.e., Response Efficacy is similar to Perceived Usefulness, Response Cost is similar to Perceived Ease of Use) that are critical to our study, but in a health behavior context. Finally, a recent call was made for C-HIT acceptance research to incorporate technology acceptance theories (Or & Karsh, 2009). By combining PMT with TTF, this paper is an answer to that call.

Educational interventions have been successfully applied to chronic care conditions such as asthma and diabetes (Guevara, et al., 2003; Sigurdardottir, et al., 2007) among others. More specifically, self-management education programs, which "emphasize the role of patient education in preventive and therapeutic health care activities" (Warsi, et al., 2004, p. 1641) can be of assistance to chronically ill patients. Improving people's health literacy has been identified as a key objective in improving the health of Americans (Pope, et al., 2006). Unfortunately, one of the groups cited as having limitations for health literacy include persons with chronic physical conditions (Pope, et al., 2006), and "the skills to increase health literacy will be critical for PHR adoption" (Kahn, et al., 2009, p. 371). Thus, in this study we propose to explore the impact of educational interventions on the various factors that influence PHR adoption. To date, no known studies have applied educational interventions to C-HIT (such as PHR) adoption, research which can potentially assist chronic disease sufferers.

The overarching objective of this paper is to develop and test a research model that combines PMT with TTF, specifically in the context of PHR adoption by chronic care patients for the purposes of self-management (note: for the remainder of the paper, we simply refer to this as PHR Adoption). We propose a survey based study that will examine the adoption intention of PHRs by chronic care patients. Furthermore, we will study the effects that educational interventions have on PHR adoption intention and its antecedents. The remainder of this paper is organized as follows. Section 2 provides the theoretical background for our research. Section 3 details our research model and the hypotheses we plan to test via our research methodology, which is included in Section 4. Finally, Section 5 details the potential contributions of this research.

THEORETICAL BACKGROUND

Protection motivation theory (PMT) is a widely adopted framework for the prediction of health-related behavior (Milne, et al., 2000). Research that utilizes PMT is typically from two main streams: i) as a framework to develop and evaluate persuasive communications (e.g., educational interventions), and ii) to predict health related behaviors (Norman, et al., 2005). Our research falls under both of these streams. PMT is a comprehensive model which has proven to be superior to other health related models with respect to the prediction of preventative behaviors (Seyde, et al., 1990) such as self-management. The PMT model contains two specific appraisals in a cognitive mediating process, namely threat appraisal (focusing on vulnerability to the threat and potential severity of the threat) and coping appraisal (focusing on the coping factors of response efficacy, self efficacy and response costs). These two appraisals lead to protection motivation, focusing on the individual's intention to perform recommended behaviors (Norman, et al., 2005). Modes of coping can be maladaptive (e.g., avoidance, denial, etc.) or adaptive (e.g., changes in health behavior such as exercise, etc.) Adoption of a PHR can be considered an adaptive coping mode in that using the PHR will involve a positive change in health related behavior. PMT has been shown to be a strong predictor of both intention and behavior (Blanchard, et al., 2009; Norman, et al., 2005) and as such, it is particularly suited to studying PHR adoption intention in our context.

Task-Technology Fit (TTF) theory was originally proposed by Goodhue (1995) who indicated the need for "some specific user evaluation construct, defined within a theoretical perspective that can usefully link underlying systems to their relevant impacts." (Goodhue, 1995, p. 1827) He proposed TTF to fill this need (Goodhue, 1995). TTF theory proposes that a better fit between technology and task will lead to better performance, either in terms of faster performance, or in terms of more effective accomplishment of tasks (Goodhue, 1995). It is this second element of performance that we are most interested in, in that better fit between the PHR technology and self-management task will lead to more effective chronic disease self-management. In addition to task and technology, there is also an individual element, whereby TTF includes "the extent that technology functionality matches task requirements and individual abilities" (Goodhue, 1995, p. 1829), in that the technology must fit both the task and the individual. One noted limitation of TTF is that it does not overtly consider the fit between the user and the task (Ammenwerth, et al., 2006), something which is very important in voluntary tasks (such as PHR adoption and use). For voluntary tasks, users must be motivated to perform the task. We therefore incorporate PMT which provides this motivational component. Additionally, Ammenwerth (2006) suggested deliberate interventions as a way to affect the TTF fit dimensions, which we designed in our research study through educational interventions. For the purposes of our study, the technology is the PHR, the individual is a chronic disease patient and the task is chronic disease self-management.

Given the focus on self-management, it is also important to understand the role that 'readiness' of the individual plays in PHR adoption. Before an individual will adopt PHR technology for the task of self-management, he/she must be ready to engage in self managing their chronic disease. For this, we draw on health care theory through the use of the Patient Activation Measure (PAM), described in more detail below.

RESEARCH MODEL

The proposed research model which combines PMT, TTF and PAM and incorporates educational interventions is shown as Figure 1, followed by brief descriptions of the constructs and proposed hypotheses.

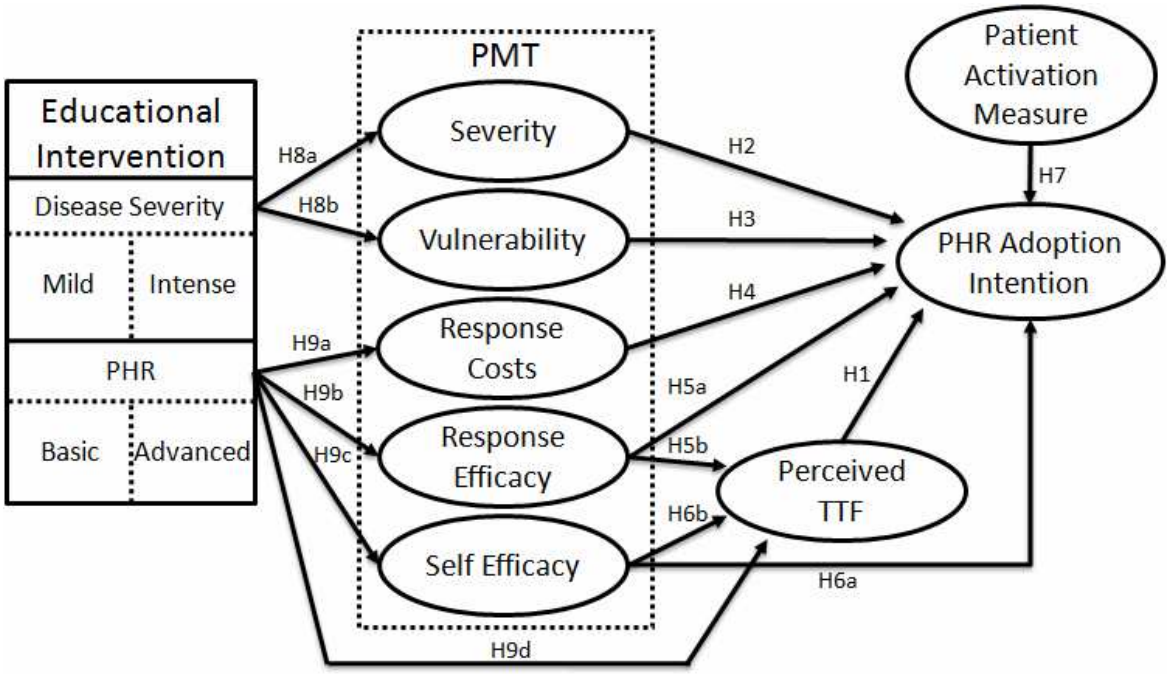

Figure 1: Research Model

PHR Adoption Intention: Our endogenous construct is PHR Adoption Intention, as behavioral intentions are typically the dependent variable in PMT studies (Floyd, et al., 2000; Rogers & Prentice-Dunn, 1997). In addition, while the dependent variable in TTF is typically Performance Impact, many TTF studies include intention either with a direct relationship with TTF and/or via a mediated relationship with TTF (Dishaw & Strong, 1998; Dishaw, et al., 2002; Klopping & McKinney, 2004; Klopping & McKinney, 2006; Lam, et al., 2007). Previous studies have shown specifically in a health-related behavior environment that intention to perform a behavior was highly correlated with [self-reported] use (Or, et al., 2008), and therefore, while this study specifically examines PHR adoption intention, this intention should correlate with actual use.

Perceived Task Technology Fit (PTTF): The TTF construct is defined as the perception that the capabilities of the technology match the user's task requirements (Lin & Huang, 2008). For our study it is the perception that the PHR matches the requirements of the chronic disease self-management task. As noted above, TTF has been shown to have significant direct relationships with intention (Klopping & McKinney, 2004; Klopping & McKinney, 2006) and therefore it is hypothesized that individuals with higher perceptions of fit will be more likely to intend to adopt the PHR.

H1 – A higher level of PTTF will positively influence PHR Adoption Intention.

All PMT constructs have been shown to have significant relationships with intention and behavior, as evidenced by two meta-analyses (Floyd, et al., 2000; Milne, et al., 2000). Below we explore each.

Severity: This threat appraisal construct is defined as "how serious the individual believes that the threat [is] to his or her own life" (Milne, et al., 2000, p. 108). It will be operationalized as the perception of how severe the risks posed by the chronic disease are to the individual's health, especially if the disease is not properly managed. It is expected that individuals who believe that the severity of the health threat posed by their chronic disease is high will be more likely to intend to adopt the PHR.

H2 – A higher level of Severity will positively influence PHR Adoption Intention.

Vulnerability: This threat appraisal construct is defined as "how personally susceptible an individual feels to the communicated threat" (Milne, et al., 2000, p. 108). It will be operationalized as the perception of how susceptible the individual feels to the threats posed by the chronic disease (i.e., will they actually get the potential negative health conditions posed by the chronic disease). It is expected that individuals who feel more susceptible to the numerous possible adverse health effects of the chronic disease will be more likely to intend to adopt the PHR.

H3 – A higher level of Vulnerability will positively influence PHR Adoption Intention.

Response Costs (RC): This coping appraisal construct is defined as "how costly performing the recommended response will be to the individual" (Milne, et al., 2000, p. 109). It will be operationalized as the costs, both potential monetary and other (e.g., time, effort, etc.) incurred by the individual in performing chronic disease self-management using the PHR. RC has a negative relationship with intentions and behaviors, and therefore we hypothesize that individuals will be less likely to intend to adopt the PHR if they deem the costs to be high.

H4 – A higher level of RC will negatively influence PHR Adoption Intention.

Response Efficacy (RE): This coping appraisal construct is defined as "beliefs about whether the recommended coping response will be effective in reducing threat to the individual" (Milne, et al., 2000, p. 109). It will be operationalized as the individual's beliefs that the use of a PHR will lead to better disease self-management. Most studies show RE to be a significant indicator of intentions (Stanley & Maddux, 1986; Tulloch, et al., 2009). It is believed that the more individuals believe that the PHR can reduce the health threat posed by their chronic disease, the more likely they are to intend to adopt the PHR.

H5a – A higher level of RE will positively influence PHR Adoption Intention.

Given the support for the relationship between PTTF and intention (Klopping & McKinney, 2004; Klopping & McKinney, 2006) and support for the relationship between RE and intention (Floyd, et al., 2000; Milne, et al., 2000), it is logical to expect that there will be a relationship between RE and PTTF, as individuals who believe the coping response (i.e., PHR for self-management) will aid them in reducing the threat of chronic disease will be more likely to believe that the PHR technology fits the task of chronic disease self-management.

H5b – A higher level of RE will positively influence PTTF.

Self Efficacy (SE): This coping appraisal construct is defined as "an individual's beliefs about whether he or she is able to perform the recommended coping response" (Milne, et al., 2000, p. 109). It will be operationalized as the individual's beliefs in their ability to use the PHR for chronic care self-management. SE has been found to be the strongest predictor of intention and more highly correlated with intention than any other PMT variable (Plotnikoff & Trinh, 2010). In addition, SE has been found to be a predictor of PTTF (Jarupathirun & Zahedi, 2007; Lin & Huang, 2008). It is believed that the more people believe in their ability to use a PHR for chronic care self-management, the more likely they are to believe that the PHR is a good fit for the task of self-management and will be more likely to intend to adopt the PHR.

H6a – A higher level of SE will positively influence PHR Adoption Intention
H6b – A higher level of SE will positively influence PTTF.

Patient Activation Measure (PAM): This formative construct measures the individual's knowledge, skill and confidence for self-management of a health or chronic condition (Hibbard, et al., 2005). Previous studies have shown that chronic care patients who score higher on PAM are more likely to adopt self-management behaviors (Mosen, et al., 2007), and therefore we expect those scoring higher on the PAM will be more likely to intend to adopt the PHR for self-management purposes.

H7 – A higher level of PAM will positively influence PHR Adoption Intention.

Educational Intervention (EI): One of the objectives of this study is to determine the effects that educational interventions have on PHR adoption. To do this, we will manipulate the levels of EI experienced by different groups in our study. Specifically, we will examine the roles of PHR Education (PE) and Disease Severity Education (DSE). A 2007 study, specifically in the context of Type 2 diabetes concluded that individuals receiving educational interventions showed "increased knowledge, self-care skills and improvements in psychological aspects" (Sigurdardottir, et al., 2007, p. 30). It is

hypothesized that the groups receiving advanced PE and/or intense DSE (both described below in the methodology) will be more likely to intend to adopt the PHR. It is further hypothesized that these educational interventions will have various effects on both the PMT and PTTF constructs.

H8a – Individuals receiving intense DSE will experience higher perceptions of Severity compared to individuals receiving mild DSE.
H8b – Individuals receiving intense DSE will experience higher perceptions of Vulnerability compared to individuals receiving mild DSE.

H9a – Individuals receiving advanced PE will experience lower perceptions of Response Costs compared to individuals receiving basic PE.
H9b – Individuals receiving advanced PE will experience higher perceptions of Response Efficacy compared to individuals receiving basic PE.
H9c – Individuals receiving advanced PE will experience higher perceptions of Self Efficacy compared to individuals receiving basic PE.
H9d – Individuals receiving advanced PE will experience higher perceptions of PTTF compared to individuals receiving basic PE.

RESEARCH METHODOLOGY

Participants in this study will be adults identified as currently suffering from Type 2 diabetes (a chronic disease) and will be recruited though local health clinics as well as through an online survey agency. Type 2 diabetics were chosen due to their need to monitor and record health related information, the potential positive health effects of self-management and the statistics (e.g., growth, etc.) of this population (DeVol & Bedroussian, 2007; World Health Organization, 2005). Due to the focus of this study on the effects of educational interventions on the adoption of PHRs, we will split participants into four equal groups, detailed below in Table 1. Educational interventions will be delivered via carefully designed video clips.

		PHR Education (PE)	
		Basic (e.g., general knowledge of PHRs, how PHRs could be used to record health information such as blood glucose levels, etc.)	**Advanced** (e.g., how the PHR can be optimized to self-manage chronic disease and detailed statistics detailing the benefits of self-management to health and life expectancy)
Disease Severity Education (DSE)*	**Mild** (e.g., high cholesterol, worsening eyesight)	Group 1 • Basic PE • Mild DSE	Group 2 • Basic PE + Advanced PE • Mild DSE
	Intense (e.g., stroke, kidney failure, blindness, amputation)	Group 3 • Basic PE • Intense DSE	Group 4 • Basic PE + Advanced PE • Intense DSE

**Note that we have chosen to focus on the negative health effects as previous studies have shown that negatively framed messages are more persuasive than positively framed messages (Block & Keller, 1995).*

Table 1: Participant Group Educational Interventions

Our research will include focus groups (approximately 5-8 people) and a small pilot survey with a convenience sample, both utilizing Type 2 diabetics as participants. The purpose of the focus groups is to develop the PMT measurement instruments and to develop/refine the educational intervention content. The purpose of the pilot will be to test and refine the measurement instruments, as well as an assessment of the educational interventions. We estimate the pilot study will have a sample size of approximately 15-20 people. For the main study, we propose a cross sectional survey that will assess PHR Adoption Intention and the relationships between the antecedent constructs. Full ethics approval will be secured prior to the initiation of the focus groups.

Wherever possible, we will strive to use previously validated instruments to measure constructs in the proposed model, as per guidelines set forth by Boudreau et al. (2001). PHR Adoption Intention will be measured using a three item, 5-point Likert scale adapted from Venkatesh et al. (2003). PAM will be measured via a thirteen item, 5-point Likert scale from Hibbard et al. (2005). Perceived TTF will be measured using an eight item, 7-point Likert scale adapted from Lin & Huang (2008). Given this is the first known research study of the application of PMT in a PHR context, we will need to develop and validate measures for the five PMT constructs. It is preferred for PMT studies to develop survey items specifically for the study (Norman, et al., 2005). A portion of the focus group sessions will be utilized to determine the most salient items for each of the PMT constructs, specifically for the use of PHRs in Type 2 diabetes self-management. These items will then be developed formally into measurement items, and evaluated and refined in the pilot study.

Our research will utilize the statistical technique of structural equation modeling (SEM) to validate the proposed model. Specifically, we will use Partial Least Squares (PLS) as it supports confirmatory and exploratory research as well as both reflective and formative constructs (Gefen, et al., 2000). The recommended sample size when using PLS is determined by the larger of 10 times the largest number of paths leading to a construct or 10 times the largest number of items in any one construct (Chin, 1997). Given that the PAM construct has thirteen items, we require a minimum sample size of 130 participants. We will therefore strive to recruit 160 participants to compensate for spoiled surveys, attrition, etc. For reflective and formative construct reliability and validity as well as content validity, we will utilize all appropriate measures and processes as per Garson (2010), Au et al. (2008) and Petter et al. (2007). Appropriate manipulation checks will be used to ensure the educational intervention manipulations were perceived to be significantly different by the four groups of participants. We will control for factors such as disease severity knowledge, PHR knowledge, duration since onset, etc. to ensure that fair between group comparisons can be made. Finally, in addition to collecting responses for our construct measures, we will also collect responses to open-ended questions relating to participant perceptions about PHRs. Responses to the open-ended questions will be analyzed to strengthen the empirical findings through triangulation (Benbasat, et al., 1987).

POTENTIAL CONTRIBUTIONS

This study will contribute to academics, practitioners and society in general. First from an academic standpoint, to the best of our knowledge this is the first known study to combine PMT with TTF. As mentioned previously, this answers the call (Or & Karsh, 2009) to incorporate IS theory into C-HIT adoption studies. Secondly, while the relationship between Self Efficacy and TTF has been proven in previous studies, this is the first known study to extend this and examine the relationship between Response Efficacy and TTF. Third, this is the first known empirical study of PHR adoption that utilizes either PMT or TTF. Finally, while the context of this research is the adoption of PHRs by Type 2 diabetics, the findings from this study will be generalizable to the larger chronic disease population, which accounts for approximately 37% of the United States (US) population (DeVol & Bedroussian, 2007).

From a practitioner perspective, this study will be valuable in determining if educational interventions are useful in improving the adoption and use of PHRs. While much time is spent determining the system design and other PHR characteristics, it is possible that simply applying education could be the tipping point that will lead to greater PHR adoption. Finally, from a societal standpoint, studies which determine how to increase the adoption of PHRs are of benefit. Governments and health care organizations around the world are discussing the benefits of PHRs and how they can assist patients and potentially reduce some of the economic burden of chronic disease health care, which by some estimates totaled $1.3 trillion (in the US) in 2003 (DeVol & Bedroussian, 2007). By better understanding PHR adoption, especially among chronic care patients, we can potentially assist society in ensuring widespread usage of PHRs, and potentially reducing some of the direct (e.g., treatment) and indirect (e.g., lost productivity) impact costs.

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