CONSUMER ADOPTION OF PERSONAL HEALTH RECORDS: AN EMPIRICAL INVESTIGATION OF PERSONAL & TECHNOLOGY FACTORS

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ABSTRACT

This paper reports the findings from a recent empirical research investigation about socio-technical factors that affect the adoption of electronic Personal Health Records (PHRs). The theoretical model posited and validated in this study draws upon various factors from the Theory of Planned Behavior (TPB), Social Cognitive Theory (SCT) and Technology Acceptance Model (TAM). The theoretical model was validated through a quantitative approach comprising an online survey questionnaire and an analysis of responses using exploratory factor analysis and structural equation modeling (SEM) techniques. The results from this study reveal that in addition to the expected positive impact of user perceptions of system usefulness and ease of use on the adoption of PHRs, other factors such as social norms and technology awareness are significantly associated with the individuals' intention to use PHR systems. The study also highlights the importance of technology anxiety as a direct antecedent of intention to adopt PHRs, as well as the relative insignificance of relationships between technical factors such as system integration capabilities and end-user perceptions about the system's usefulness. These differential effects of adoption factors are discussed in the paper. This paper contributes to the extant research literature on consumer health informatics (CHI). Through a discussion of our results, we also aim to provide recommendations and guidelines for PHR vendors and service providers in the design and delivery of PHRs and other self-management health technologies. The research findings may also be relevant for government institutions, policy makers and healthcare practitioners to aid their understanding of consumer adoption issues pertinent to PHRs.

KEYWORDS

Personal Health Records, PHR, Patient Facing Information Systems, Technology Acceptance, Consumer Adoption, Consumer Health Informatics.

1. INTRODUCTION

Personal Health Records (PHRs) represent a burgeoning technology that is gaining traction in many countries around the world (Kahn et al., 2009; Pinciroli and Pagliari, 2015; Wolfson, 2010). As a consumer-centric technology, personal health records can be defined as "*an electronic application through which individuals can access, manage and share their health information and that of others for whom they are authorized, in a private, secure and confidential environment*" (Markle Foundation, 2003). Toward this, PHR systems comprise information and communication technologies (ICTs) that can potentially help all types of end-users in maintaining health and wellness, and specifically facilitate patients manage ongoing illnesses (Tang et al., 2006).

The overarching vision behind PHR technology offerings is to enable patient empowerment, reduced healthcare costs and better continuity of care (Greenhalgh et al., 2010) through access to timely, reliable and comprehensible health information for patients, and streamlined communication among patients and healthcare providers (Demiris, 2012; Smith et al., 2012).

Despite the touted benefits and predicted market potential for PHR technologies, the uptake of these technologies has been slow and the overall adoption rates remain low (Gartrell, 2015; Greenhalgh et al., 2010). Researchers who have investigated the consumer acceptance of PHRs have posited that possible adoption barriers may be related to technology factors such as privacy and security concerns, system usability, and poor integration with healthcare provider systems (Gamble, 2009; Maloney and Wright, 2010), or to personal factors such as inadequate technology competency, low technology awareness, unrealistic

expectations, and presence of chronic conditions (Weitzman et al., 2009; Wynia and Dunn, 2010). Some of these factors have been empirically validated in recent studies, but results across these studies are often inconsistent (Archer and Cocosila, 2012; Archer et al., 2011; Cocosila and Archer, 2012; Emani et al., 2012; Pushpangadan and Seckman, 2015). As such, additional research in this area has been recommended by many researchers to further explore the impact of personal, technological, organizational and environmental factors on the acceptance of PHR technologies by patients and caregivers (Emani et al., 2012; Logue and Effken, 2012; Luque et al., 2013; Nazi, 2013; Pushpangadan and Seckman, 2015). This paper answers this call by theorizing and validating the role of various personal and technological factors as possible determinants of PHR adoption. We aim to contribute to the body of knowledge on the adoption of PHR systems by exploring sociotechnical factors that further clarify or complement those previously studied by other researchers.

The next section in this paper outlines the premise of our research study and the basis for our theoretical model. This is followed by a description of our research methodology and the results. Finally, the discussion and conclusion sections offer an interpretation of the results, especially with respect to their implications for research and practice.

2. THEORETICAL MODEL

To proceed with the investigation of personal and technological factors affecting the adoption of PHR technologies, a theoretical model was formulated to test and validate relationships among various cognitive, affective and behavioral constructs. The personal factors explored in this study include social norms, technology awareness, and technology anxiety, while the technology factors include perceptions about system integration, technology usefulness, and ease of use and accessibility of the technology. Figure 1 depicts the theoretical model for this research study.

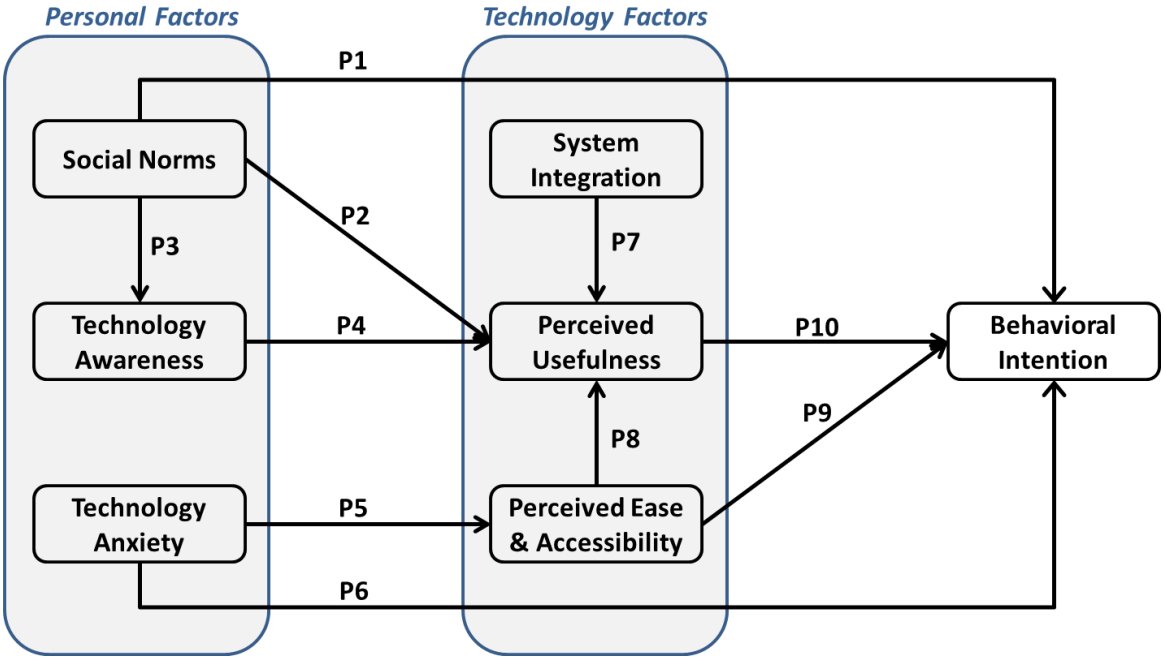

Figure 1. Theoretical Model for This Study

In formulating the theoretical model, this research draws upon three key theoretical frameworks from the extant literature: Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989), Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991; Fishbein and Ajzen, 1975), and Social Cognitive Theory (SCT) (Bandura, 1986, 1991; Wood and Bandura, 1989). Table 1 summarizes the various themes and constructs in the theoretical model and provides a brief description for each construct in the model. The constructs and interrelated propositions are described below.

Table 1. Theoretical Model Components

Theme	Constructs	Conceptual Definition
Personal Factors (Determinants)	Social Norms	Persons' informal beliefs about what others do and what they should do (Cialdini, 2003)
	Technology Anxiety	An individual's apprehension or fear when confronted with the use of technology (Simonson et al., 1995)
	Technology Awareness	An individual's familiarity with the purpose and benefits of the technology (Agarwal and Prasad, 1998)
Technology Factors (Determinants)	Perceived Usefulness	The degree to which an individual believes that using the system will help him or her towards achieving their desired goals (Davis, 1989; Venkatesh and Davis, 2000)
	Perceived Ease & Accessibility	The degree of ease associated with the system (Davis, 1989; Venkatesh and Davis, 2000), especially with respect to an interface and information structure that is comprehensible and available (Teo et al., 2003)
	System Integration	Extent of connection and interoperability among technology components and subsystems (Iacovou et al., 1995)
Adoption Outcome (Consequent)	Behavioral Intention	The degree to which a person has formulated conscious plans to perform or not perform some specified future behavior (Venkatesh and Davis, 2000)

To characterize the adoption of PHRs, we utilize *behavioral intention* as the dependent variable in our model. The construct has been commonly deployed in the information systems (IS) literature to study the adoption of various types of technologies (Davis, 1989; Davis et al., 1989) including PHRs (Archer and Cocosila, 2014; Cocosila and Archer, 2012).

With respect to *personal factors*, this study explores factors that underlie normative beliefs and self-regulatory mechanisms as individual difference variables that affect the adoption of PHRs. Firstly, we draw upon TPB to include *social norms* as an antecedent of behavioral intention (Ajzen, 1991). In doing so, we hypothesize that consumers' behavioral response towards PHRs will be affected by whether they consider it to be normal to use these systems. Secondly, we posit *technology anxiety* as an affective construct that impacts the adoption of PHRs. SCT provides the basis for this construct through its emphasis on the role of self-efficacy which represents an individual's beliefs about his or her capabilities to use a technology. Prior IS research has validated the relationship between self-efficacy and anxiety (Compeau et al., 1999). In this study, we explore the direct link between anxiety and behavioral intention, and its indirect effect on perceptions of ease of use and accessibility. Towards the latter, we ground our hypothesis in the context of recent IS studies that have shown anxiety to be an important antecedent of perceived ease of use (Hackbarth et al., 2003; Saadé and Kira, 2009). Lastly, in considering PHRs as an innovation, we posit *technology awareness* to be a prerequisite to the development of perceptions about its usefulness. This hypothesis is consistent with the extant discourse on technology adoption (Agarwal and Prasad, 1998; Jeyaraj et al., 2006). To our knowledge, very few studies specific to PHR adoption have empirically validated the role of awareness despite several calls to address this issue (Whetstone and Goldsmith, 2009; Xie et al., 2014).

Propositions pertaining to personal constructs in the theoretical model are as follows:

- P1: Social Norms pertaining to the use of PHR technologies have a positive effect on the Behavioral Intention to Use PHR technologies
- P2: Social Norms pertaining to the use of PHR technologies have a positive effect on the Perceived Usefulness of PHR technologies
- P3: Social Norms pertaining to the use of PHR technologies have a positive effect on the Technology Awareness of PHR technologies
- P4: Technology Awareness of PHR technologies has a positive effect on the Perceived Usefulness of PHR technologies
- P5: Technology Anxiety has a negative effect on the Perceived Ease & Accessibility of PHR technologies
- P6: Technology Anxiety has a negative effect on the Behavioral Intention to Use PHR technologies

In terms of *technology factors*, the theoretical model includes factors that are expected to impact a person's cognitive, affective and behavioral responses towards PHR technologies. The model draws upon TAM to conceptualize users' acceptance of PHRs based on their perceptions of *usefulness* and *ease of use*. With respect to the latter, our model also includes *accessibility* within the conceptualization of the construct as many researchers have discussed the association between usability and accessibility in the context of PHR technologies (Goldberg et al., 2011; Siek et al., 2009). In general, we contend that ease of use of PHRs is related to the technologies being perceived as effort-free as possible in terms of configuration requirements, comprehensibility of information, and availability anytime anywhere. Additionally, our model incorporates *system integration* as a posited antecedent of perceived usefulness. Researchers as well as practitioners have often commented that poor integration and interoperability between back-end electronic health records on the provider side and front-end PHRs on the consumer side is a barrier in the adoption of PHR technologies (Lahteenmaki et al., 2009; Pringle and Lippitt, 2009). However, there is a dearth of research validating the link between integration capabilities of PHRs and their perceived usefulness. Our study aims to address this gap.

Propositions pertaining to technology constructs in the theoretical model are as follows:

- P7: System Integration capabilities of PHR technologies have a positive impact on the Perceived Usefulness of PHR technologies
- P8: Perceived Ease & Accessibility of PHR technologies has a positive impact on the Perceived Usefulness of PHR technologies
- P9: Perceived Ease & Accessibility of PHR technologies has a positive impact on the Behavioral Intention to Use PHR technologies
- P10: Perceived Usefulness of PHR technologies has a positive impact on the Behavioral Intention to Use PHR technologies.

3. METHODOLOGY

Data for this study were collected through an online survey that was administered to actual and potential users of PHR technologies. Call for participation in the research study was communicated through various online forums and social media groups dedicated to the discussion of health related subjects. The sampling techniques used were primarily convenience and self-selection based. Qualifying questions were asked at the beginning of the survey to ensure that respondents had basic familiarity with PHRs or similar tools for healthcare self-management.

The survey comprised demographic information questions, technographic behavioral items related to technology expectations and extent of use of technologies, and psychographic perceptions based questions pertaining to the theoretical model. The survey questions pertaining to the theoretical constructs were adapted from item scales that had been previously used and validated in other research. Appendix A lists the survey measurement items that were utilized for each of the constructs in the theoretical model.

Prior to rollout, a draft version of the survey was pre-tested using 15 respondents from the planned sampling frame, allowing the language of the survey to be improved, terminology to be clarified, and item measurement scales to be verified.

In terms of analysis procedures, the demographic and technographic variables were analyzed using descriptive statistics and non-parametric statistical tests. Testing of theoretical constructs and relational propositions from the theoretical model was conducted through exploratory factor analysis and structural equation modeling techniques. The measurement and structural models were estimated by using the structural equation modeling facilities of Smart PLS (Ringle et al., 2013).

4. RESULTS

A total of 210 responses were collected from across the various online forums and social media groups. After discarding partial responses, a total of 130 responses were retained for further statistical analysis. With respect to demographics, the average age of respondents fell around the 25–34 years frequency, males comprised 54% of the sample, and 80% of the respondents were from USA or Canada.

With respect to technographic patterns in the behavior of using self-management tools for healthcare, while only 5% of respondents indicated the use of a formal PHR systems, 30% of respondents indicated use of "other" website platforms and 10% indicated use of "other" mobile applications to maintain personal health information. Corresponding to the respondents who indicated some use of these technologies, 35% of them identified themselves as patients and 5% as caregivers, while the rest indicated use due to interest in the technology or simply to maintain personal health information.

The measurement model was assessed through various tests for discriminant and convergent validities for the constructs in the theoretical model. Firstly, discriminant validity was tested as per guidelines provided by Fornell and Larcker (Fornell and Larcker, 1981) to ensure that the theoretical model constructs were all distinct. A visual inspection of Table 2 shows that the square root of the average variance shared by items within a construct (shown in bold on the diagonal) exceeds the inter-construct correlations that appear below and beside them. Secondly, various tests of convergent validity were performed through an assessment of various quality indices as shown in Table 3. As shown, the average variance extracted (AVE) value for each latent variable is higher than 0.5, indicating that at least 50% of the variance in each block of indicators can be attributed to the pertinent latent variables (Chin, 1998; Fornell and Larcker, 1981). Moreover, the values of Cronbach's alpha are in the range of 0.60 to 0.70, hence showing the internal reliability consistency of construct at an individual level (Gefen et al., 2000). Furthermore, composite reliability values for each construct are higher than 0.70 which is the recommended cut-off to validate the internal reliability consistency relative to all other constructs in the model (Fornell and Larcker, 1981).

Table 2. Discriminant Validity Assessment of the Measurement Model

Constructs	BI	PE&A	PU	SN	SI	TAnx	TAw
Behavioral Intention	**0.788**						
Perceived Ease & Accessibility	0.640	**0.769**					
Perceived Usefulness	0.742	0.488	**0.826**				
Social Norms	0.627	0.687	0.546	**0.746**			
System Integration	0.567	0.635	0.461	0.568	**0.785**		
Technology Anxiety	-0.231	0.015	-0.155	0.041	0.060	**0.764**	
Technology Awareness	0.428	0.689	0.524	0.614	0.497	0.146	**0.814**

Table 3. Convergent Validity Assessment of the Measurement Model

Latent Variables	Convergent Validity Indicators		
	AVE	Composite Reliability	Cronbach's Alpha
Behavioral Intention	0.614	0.827	0.686
Perceived Ease & Accessibility	0.597	0.898	0.864
Perceived Usefulness	0.683	0.866	0.768
Social Norms	0.563	0.794	0.615
System Integration	0.622	0.866	0.768
Technology Anxiety	0.580	0.803	0.652
Technology Awareness	0.662	0.854	0.746

In order to estimate the structural model, path coefficients and significance levels were obtained by running SmartPLS with bootstrapping using 500 re-samples. The structural model and the p-values are presented in Figure 2 with results depicted along each path. As shown in Figure 2, six of the 10 proposed paths were supported with high degrees of confidence.

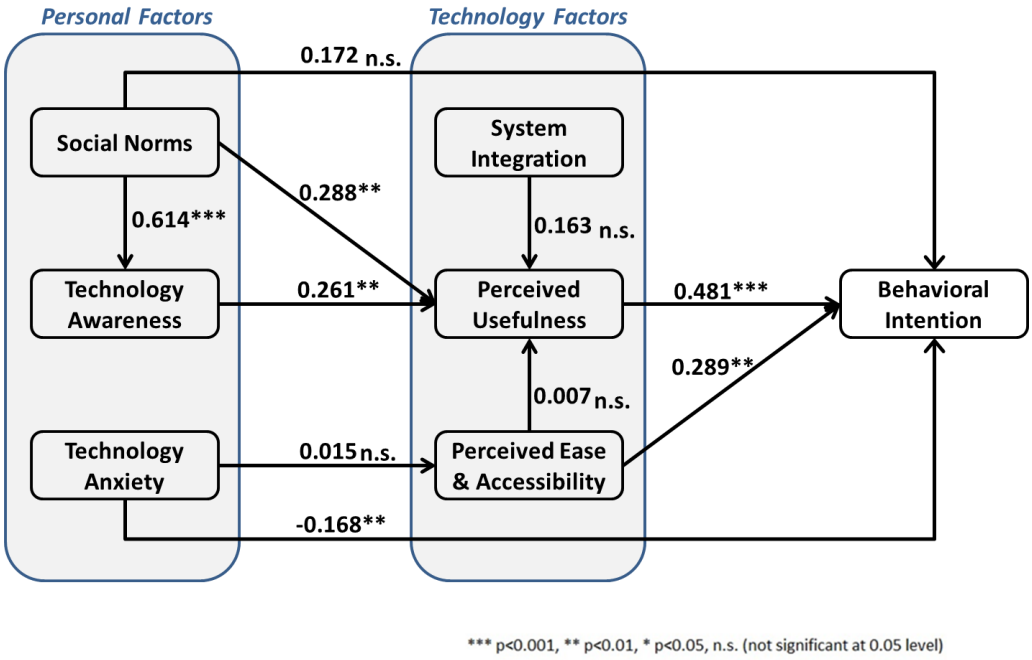

Figure 2. Theoretical Model Path Coefficients

With respect of personal factors, no significant relationship emerged between Social Norms and Behavioral Intention to adopt PHR technologies (P1 not supported). However, as predicted, Social Norms had a significant positive effect on Perceived Usefulness (P2 supported) and Technology Awareness (P3 supported). The path from Technology Awareness to Perceived Usefulness was also supported in the model (P4 supported). In terms of the effects of Technology Anxiety with PHRs, no significant association was found with Perceived Ease & Accessibility (P5 not supported), but a direct relationship with Behavioral intention to use PHR technologies was validated (P6 supported).

The results pertaining to technology factors indicate that contrary to expectations, neither System Integration nor Perceived Ease & Accessibility had a direct positive effect on the Perceived Usefulness of PHR technologies (P7 and P8 not supported). However, the effects of Perceived Ease & Accessibility and Perceived Usefulness of PHRs on the Behavioral intention to use these technologies were supported (P9 and P10 supported).

In determining the efficacy of the model in terms of predictability, the model performed well with respect to the main downstream endogenous variable of Behavioral Intention to adopt PHR technologies. An R^2 value of 0.689 suggests that approximately 69% of the construct's variance can be predicted by antecedent constructs in the model. While there is no specific cut-off value for measuring R^2, generally higher values are considered favorable (Gefen et al., 2000), and some researchers suggest that values higher than 0.10 can be deciphered to indicate the usefulness of an endogenous variable within the model (Falk and Miller, 1992).

For assessing the goodness of fit for the structural model, we used the global criterion of goodness-of-fit (0 <= GoF <=1) to evaluate the model fit (Tenenhaus et al., 2005). For this model, the resulting GoF value of 0.480 exceeded the cut-off value for large effect sizes (R^2) of 0.35. Hence, it can be inferred that the structural model performed well overall.

5. DISCUSSION

The results outlined in the previous section corroborate the general premise that a combination of personal and technological factors play a role in determining the adoption of PHR technologies. This section provides an interpretation of the results and deliberates the implications for research and practice.

5.1 Personal Factors

Our results show that social norms pertaining to the use of PHR systems do not directly affect a person's adoption of these technologies. However, these informal beliefs about other people also using PHR technologies can improve the individual's awareness of the technology, and also lead the person to develop a better perception of the system's usefulness. These differential effects of social norms suggest the importance of internalization as a progressive process in the adoption of PHR applications. Lack of a direct relationship between social norms and behavioral intention suggests that merely the belief of others using PHRs is not sufficient in itself towards the adoption of such technologies, at least not until these beliefs are internalized through cognitive mechanisms that allow the individual to make sense of the technology's purpose and benefits.

The positive impact of technology awareness on perceived usefulness also alludes to a process of internalization whereby consumers' familiarity with the purpose and benefits of PHR technologies allows them to develop beliefs about the technology's overall usefulness in their specific context. Since the use of PHR systems is voluntary, it is reasonable to assume that consumers would take their time to discover and understand the technology before deciding to adopt it. The relationship between social norms and technology awareness implies that observations and interactions with other people play an important role in this process.

Our results also identify the critical role of technology anxiety as a determinant of PHR systems adoption. While no significant relationship emerged between technology anxiety and perceived ease & accessibility, the construct exhibited a significant direct impact on the behavioral intention to adopt PHR technologies. With respect to the former, while recent IS studies have shown anxiety to be an important antecedent of perceived ease of use (Hackbarth et al., 2003; Saadé and Kira, 2009), our study did not support this relationship. This finding can probably be attributed to a difference in the type of technology being investigated, as previous studies have generally focused on mandatory use technologies or hedonic technologies. In the case of PHR applications, the technologies are expressly voluntary and instrumental for most consumers. It should also be noted that in adopting the current conceptualization of technology anxiety from the extant IS literature, we might have overlooked the multidimensional nature of anxiety as a psychological construct. Aligned with the IS literature, our construct conceptualization is reflective of anticipatory anxiety (apprehension preceding the use of PHR systems) rather than situational anxiety (distress during the use of PHR systems). The latter may indeed exhibit a relationship with perceived ease of use and accessibility. Therefore, we recommend that the multidimensional nature of technology anxiety and its role in the adoption of PHR systems be investigated in future research.

5.2 Technology Factors

The lack of support for the relationship between system integration features and perceptions of usefulness of PHR technologies was counterintuitive. In the context of PHRs, it can be expected that better functionality of these systems in terms of connection and interoperability with other backed systems such as provider electronic health records and payer transaction management systems would translate into better perceptions about the system's usefulness. This posture is supported by current research on PHR systems that considers a lack of integration between patient facing systems and backend electronic health systems as a barrier to adoption for both consumers as well as health care professionals (Lahteenmaki et al., 2009; Nazi, 2013). The inconsistent finding in our study may be attributed to our stance (noted above) that the development of cognitive beliefs about PHR systems is a gradual process requiring internalization. In the context of technological features, this would entail an assimilation of system features into higher order cognitive states that represent perceptions of usefulness of the system. As such, in our theoretical model, the system integration construct is conceptualized in the form of initial expectations pertaining to PHR technologies, and it does not capture or measure aspects of assimilation of these technologies. Therefore, we suggest that future studies use a different approach to model the relationship between system integration and perceived usefulness. One possibility may be to draw upon experience-disconfirmation theory (EDT) which has its roots in consumer behavior research (Oliver, 1980), and posits that beliefs and behaviors result from the congruence between expectations and experiences (Venkatesh and Goyal, 2010).

Secondly, unlike many studies investigating technology adoption, our results did not find a significant relationship between perceived ease and accessibility and perceived usefulness. While this finding may be at odds with the general IS literature, the findings are not as surprising in the specific context of PHR systems adoption. Previous studies on PHR technology adoption show varied results pertaining to the effects of perceived ease of use – some studies confirm the construct's relationships in the technology acceptance model (Or et al., 2011), while others contradict them (Liu et al., 2013). We offer a possible explanation for this lack of a significant relationship by noting that PHR systems are characterized by their voluntary and instrumental use by potential end-users, and as such, these systems require an extended commitment on part of the end-users to keep the system up-to-date and to keep it relevant and useful over time. Such systems have recently been the subject of IS research under the category of high maintenance information systems (HMIS) (Assadi and Hassanein, 2010). Initial research on HMIS contends that ease of use may not be as prominent a determinant of usefulness and behavioral intention as its effect is usually superseded by the effect of other variables such as perceived maintenance effort (Assadi and Hassanein, 2010). In the case of PHR technologies, we expect a greater role for a construct such as perceived maintenance effort, and future studies should incorporate this variable in their models.

In terms of direct effects on behavioral intention to adopt PHR systems, our results are consistent with the extant research literature. The role of perceived ease and accessibility and perceived usefulness as antecedents of behavioral intention to adopt PHR systems is validated, supporting the premise that functionality, ease of use, and accessibility are important facilitators towards the adoption of PHR systems. Furthermore, having demonstrated internal reliability and construct validity, our integrated conceptualization of perceived ease and accessibility shows promise in the context of studying PHR technologies and it lends support to many researchers' viewpoint of the synergistic relationship between usability and accessibility (Goldberg et al., 2011; Kahn et al., 2009; Siek et al., 2009).

5.3 Limitations of this Study

As an exploratory study, our research has inherent limitations in terms of the posited theoretical model. This includes propositions that did not emerge as significant. However, our discussion on principal results provides possible explanations for these findings and suggests avenues for future research.

Other limitations of our study pertain to the use of convenience and self-selection sampling techniques. This may limit the generalizability of the study's results. Furthermore, most of the respondents comprised a younger age demographic from North America, and the results may not be representative of the general population. We also note that the data were collected through an online survey targeted at respondents interested in health self-management. This limits our findings to current internet users with potentially higher health literacy, and may not accurately account for the population of users with lesser access to computing resources. Future research should include potential as well as actual users of PHR technologies and utilize recruitment mechanisms to alleviate sampling bias.

5.4 Implications for Research & Practice

Based on the analysis and interpretation of the results from our investigation, we can offer several recommendations for research and practice to help with the study, design and implementation of personal health record technologies.

Future studies should further investigate the role of norm internalization and technology assimilation as individual psychological processes affecting behavior towards PHR technologies. We suggest that the relationships among constructs be modeled to reflect a gradual process in the development of beliefs about PHR technologies and their consequent adoption. Toward this, incorporating mediating constructs from EDT could provide potentially valuable insights.

Future research should also seek to explore and validate the potentially multidimensional nature of some of the personal constructs posited in our theoretical model. Specifically, technology anxiety should be studied in terms of anticipatory and situational anxiety. We believe that both of these dimensions play an important role during different stages of adoption of PHR technologies. Similarly, on the technology side, system integration should be operationalized through specific attributes of integration such as single window patient information access, system-to-system health data sharing, as well as information communication capabilities

such as patient-doctor exchanges. Doing so would also have the added benefit of deconstructing specific needs and preferences of consumers in terms of their expectations of integration features and functions between PHR technologies and other healthcare information systems.

In terms of implications for practice, through our research, we are able to offer recommendations for PHR designers and vendors, healthcare professionals, as well as policy makers. For technology design, our study highlights the importance of accessible ICTs that should aim to assist end-users' interactions with the technology features of PHR systems and support a gradual learning curve. Technology should be developed in such a way as to mitigate against anticipatory and situational anxiety with PHR technologies, and help end-users feel in control of the system. A delineation of basic versus advanced features, context-sensitive suggestions for tasks and actions, and readily available technical support may help improve the overall user experience with PHR systems.

Technology vendors can also help improve the uptake of their PHR systems by way of influencing personal affective and cognitive beliefs that factor into behavior towards PHR technologies. For example, technology awareness can be improved and technology anxiety can be reduced by incorporating additional aspects of trialability and observability in PHR offerings. Availability of free trial versions of software, interactive demonstration vignettes and how-videos, access to a community of end-users, and spotlights on positive consumer stories are just some potential mechanisms to help alleviate challenges pertaining to technology anxiety and awareness.

From a policy perspective, concerned agencies should prioritize training and development initiatives for people to become more proficient with the use of PHR systems. The target audience for such programs should include both consumers as well as healthcare professionals. The latter factor into the technology adoption process as key influencers – their engagement with patients and their endorsement of relevant PHR applications can accelerate the uptake of these technologies.

6. CONCLUSION

The empirical research findings reported in this paper aim to contribute to the extant literature on the consumer adoption of PHRs. Toward this, we have attempted to explore and analyze possible factors contributing to what has been termed as the *PHR paradox* (Nazi, 2013), i.e. despite their predicted benefits and considerable consumer interest, the adoption of PHRs has generally remained low.

Our results indicate that social norms, technology awareness and technology anxiety are important factors that foreshadow individuals' attitudes and beliefs about the usefulness of PHR systems, and the ultimate adoption of these technologies for health self-management. Our study also shows the lack of significant relationships between system integration capabilities, ease of use and accessibility, and end-user perceptions about the system's usefulness. Our characterization of PHR technologies in terms of their voluntary, instrumental and high maintenance attributes has allowed us to make sense of these seemingly counterintuitive findings about technology antecedents of PHR adoption.

As such, our findings support the viewpoint of other researchers who contend that PHR technologies are complex innovations in which perceived attributes of technology are neither stable features nor sure determinants of adoption (Greenhalgh et al., 2010; Nazi, 2013). It is hoped that the take-aways from our study will prove to be constructive in helping align PHR offerings more closely with consumer beliefs and attitudes, informational needs, and functional requirements, and in alleviating the risk of PHR technology rejection or post-adoption abandonment.

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APPENDIX A. Measurement Items for Model Constructs

Theoretical Construct	Measurement Indicators
	All indicators on a 7-point Likert Scale from 1: Strongly Disagree to 7: Strongly Agree.
Social Norms	• It is commonplace now for individuals to maintain their health records using PHRs. • I believe using Personal health records is normal in today's society. • Using PHRs is considered to be a regular health management practice.
Technology Awareness	• I am aware of the benefits of personal health records as a self-health management tool. • I know what a PHR is and how it works. • I have enough information in order to decide using PHR for my health management.
Technology Anxiety	• I would hesitate to use a PHR system due to fear of making mistakes I cannot correct. • I would feel nervous in using PHR technology applications for accomplishing tasks. • I have low confidence in my skills to use PHR technologies.
System Integration	• I expect PHR systems to provide access to my entire health records in one place. • PHR applications would usually be integrated with other electronic health records. • My PHR should be able to send and receive information from other systems that keep my health data.
Perceived Ease & Accessibility	• I believe a Personal Health Record system is easy to use. • I think it is easy to interact with PHR systems. • PHR systems are easy to learn. • Information from PHR systems can be accessed anywhere anytime. • PHR systems present information in a clear fashion. • PHR systems are available when I need them.
Perceived Usefulness	• I believe the Personal Health Record is a useful technology to manage health conditions. • Using Personal Health Records has a lot of advantages for health management. • PHR systems are capable of providing benefits in individual health management.
Behavioral Intention to Adopt	• If a Personal Health Record is made available to me, I intend to use it. • I would like to use PHR system for keeping my health records up to date. • I would consider using a PHR system to manage my health information in the future.