# MODELING CONSUMER ACCEPTANCE OF ELECTRONIC PERSONAL HEALTH RECORDS

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## ABSTRACT

The goal of this study is to build and empirically validate a theoretical model differentiating between consumer information-related and technology-related factors of adopting electronic personal health records (PHRs). Encouraging healthy people to monitor their own health, record data in online PHRs, and engage more in health self-management can help to improve their lives while saving health system costs by preventing rather than treating diseases. To elicit consumer views on PHRs and test the adoption model proposed, a cross-sectional theory-based survey was conducted with a panel of 383 Canadian individuals. Results demonstrate a valid model according to which technology-related perceptions are more important than information-related perceptions for PHR adoption. Overall, this study opens the door for further investigations of healthy consumer views on PHRs in order to understand the factors that would increase the adoption rate of this new artifact in health promotion with society-wide positive implications.

Keywords: Personal health records; Information technology; Adoption; Survey

## 1. Introduction

Contemporary society is facing unprecedented pressures to provide better but also cost-effective care to an aging population that is currently affected by a growth in the occurrence rate of chronic health problems [Meetoo 2008; Mehravar et al. 2016; Zakaria & Shaw 2017]. Besides additional financial efforts for increasing the quality of actual healthcare delivery, another approach towards meeting these contradictory demands is to encourage the use of healthcare Information Technology (IT) tools that can provide relevant information efficiently at the point of care and thus increase the overall performance of care provision [Pinsonneault et al. 2017]. The most popular of these IT tools are computer-based clinical records for record keeping and data storage in healthcare institutions and physician offices, generically known as Electronic Medical Record (EMR) or Electronic Health Record (EHR) systems that "play a central role in health institutions" [Aanestad et al. 2017, p. 13].

While these systems can help care providers to make informed decisions about their patients, a relatively newer approach using Personal Health Records (PHRs) is going a step farther by encouraging patients and the general public to maintain their own health records for use in health self-management. Thus, PHRs tend to broadly mirror EMRs or EHRs except that PHRs are maintained by people monitoring their own health.

Although PHRs can also be maintained in a paper format, the focus of this article is on electronic PHRs only, and the term 'PHR' will refer both to electronic personal health records and to the information systems used to support them. Much of the impetus to encourage adoption of PHRs is coming from a growing interest in patient health self-management, which can be supported by patient self-monitoring and record keeping available, for example, through integrated PHRs that also provide consumer online access to provider-based records [Detmer et al. 2008].

PHRs can empower patients and move them from a role as passive recipients of healthcare services to an active role in which they self-monitor their condition, acquire, manage and communicate health-related information, identify health care choices, and participate in the decision-making process regarding their health needs [Demiris et al. 2008; Ozok et al. 2017]. Ideally, PHRs facilitate timely and cost-effective access to information about individual healthcare history and topics that relate specifically to certain chronic diseases or conditions [Archer et al. 2011; Kaelber & Pan

2008]. Also, PHRs in electronic form would match the picture of the envisioned "collaborative, mobile, and accessible health care" achieved through e-health systems [Mouttham et al. 2012].

Encouraging the use of PHRs may have positive consequences for all major stakeholders in the healthcare system: the general population receives better care while healthcare systems and society save resources. However, as for virtually any innovative use of an IT application, potential user perceptions are the key factor that has to be accounted for to ensure the ultimate success of its use [Venkatesh et al. 2002]. Investigating user perceptions and intentions to use PHRs is, therefore, of utmost importance in a consumer-sensitive sector like healthcare.

Past studies explored patient or care provider perceptions about using PHRs [Emani et al. 2012; Karagiannis et al. 2007] or on sharing personal data through actual PHR applications [Weitzman et al. 2010; Zulman et al. 2011] with encouraging results. However, scientific investigation of perceptions about PHRs by potential users that are not also patients has received less attention. This category of consumers is, nonetheless, important for the cost-effective delivery of contemporary healthcare [Wen et al. 2007] as it is well-known that prevention is better than cure. Thus, preserving health is a win-win situation beneficial for both well individuals (who are able to live better lives) and society (who can focus healthcare resources and efforts on patients with immediate needs). On the other hand, acceptance of PHRs by consumers in general is likely to be more difficult to achieve since healthy people tend to be less concerned about future healthcare issues. This is similar to ensuring well peoples' adherence to health promotion programs (e.g., exercising more, eating healthier, or even getting vaccinated against flu) that has been demonstrated to be difficult to achieve since such programs do not have immediate and obvious outcomes [Ackermann et al. 2015; Vilella et al. 2004].

To fill this knowledge gap, we developed a theoretical model of the perceptions of the general population about the potential for PHR adoption and validated it empirically with a sample of 383 Canadian consumers. This article reports on the research as follows: the next two sections describe the theoretical background and the related research model we constructed. Following these are sections that present the methodological approach and the main results, as well as discussion and conclusions.

## 2. Theoretical Framework

Personal Health Record systems are gaining increased popularity in today's society for several reasons. The first is the current widespread tendency to move toward patient-centered healthcare. Engaging patients in monitoring and managing their own healthcare has potentially better outcomes and lower costs for themselves, healthcare systems, and society [Demiris et al. 2008]. Self-management of healthcare would be difficult without a tool to monitor and record healthcare history and related information, hence the necessity for PHRs.

Secondly, society is encouraging the delivery of medical care in ambulatory conditions for many categories of chronically ill, recovering, and aging patients, in order to delay or avoid permanent institutionalization. This approach is driven by the need to provide better care with reasonable costs to an aging population that suffers from a high incidence of chronic illnesses [Eysenbach 2000; Watari et al. 2006]. Providing ambulatory care to patients effectively requires, among other things, monitoring patient history and clinical interventions through PHR system support.

A third reason for the increasing popularity of PHRs is that access to the Internet and other media tools has made consumers more conscious about and educated on healthcare issues, and willing to do more to preserve and improve their wellness through lifestyle choices [Bliemel & Hassanein 2007]. To achieve all these goals it is necessary to ensure regular self-monitoring of health status through tools such as PHRs (e.g., regularly recording weight, blood pressure, blood glucose, exercise, etc.).

Virtually all current PHRs are in electronic format and accessible online. This parallels the increasing use of Electronic Health Record (EHR) systems by physicians and healthcare institutions that are becoming mandatory in today's provision of quality medical care [Archer & Cocosila 2011]. Thus, to be fully beneficial, PHRs should be able to exchange useful information with EHRs [Detmer et al. 2008], allowing health professionals to make timely and documented interventions. The use of PHRs has also been simplified by the increasing popularity of various computing devices with Internet access capabilities (ranging from desktop personal computers to smart phones) as well as to the increased skills of the general population in using these devices.

As suggested by the discussion above, there are apparent advantages of PHRs for all major stakeholders in healthcare, including the general public. However, research is needed to confirm that these advantages are fully perceived and appreciated by potential end users, especially for a sensitive sector such as healthcare [Archer & Cocosila 2014; Cocosila & Archer 2014].

Information systems research to investigate information technology adoption factors using various theories and models has been a traditional area of study [Venkatesh et al. 2002], as user views are essential for the success of any IT innovation. The majority of technology adoption research has found that perceived usefulness (or performance expectancy) is the main reason for using an IT artifact [Venkatesh et al. 2002]. It is, therefore, expected that this factor

will also be a pivotal driver of PHR use. That is, people will use PHRs if they perceive their usefulness in helping to maintain a healthy life.

A more granular look at PHR philosophy and functionality suggests additional factors that should be considered in the adoption equation of these artifacts. Thus, "a PHR includes health information managed by the individual" [Tang et al. 2006] and the key purpose of such an application is to allow consumers in general (hence not necessarily patients) to "access, manage and share their health information" with authorized persons (e.g., their health providers) "in a private, secure, and confidential environment" [Markle Foundation 2003]. Therefore, theoretical reasoning relying on the above characteristics indicates two broad categories of factors that would influence user adoption of PHRs, in addition to their perceived usefulness:

- *information-related* (or 'soft') factors - e.g., people would use these applications because they need to be informed on their health condition and also to manage this type of information as needed, and
- *technology-related* (or 'hard') factors - e.g., individuals would use these applications because they also have the skills and confidence to use the necessary information technology.

Based on the above, in order to understand the main factors influencing PHR adoption from the perspective of healthy potential end users, this study poses the following research question:
*What are the key information-related and technology-related factors that influence consumer perceptions of the adoption of Personal Health Record systems?*

## 3. Research Model Development

To investigate consumer perceptions of the adoption of PHR systems, a theoretical model was developed, starting from the technology adoption body of knowledge that has been validated by previous research in information systems (IS), including for health information technology [Sun & Qu 2015]. Thus, the model in this research relies on the theoretical foundation of the popular Technology Acceptance Model (TAM). TAM posits that two user beliefs (Perceived Usefulness and Perceived Ease of Use) are instrumental in explaining individual intentions of using an IT artifact [Davis 1989; Davis et al. 1989]. TAM-derived models have been used in numerous studies investigating technology adoption in eCommerce [Wirtz & Göttel 2016] as well as for various healthcare IT contexts [Holden & Karsh 2010; Hsiao & Chen 2016; Sun et al. 2013] due to TAM's high explanatory power and parsimony.

Potential constructs were added to TAM's framework that could affect intentions to adopt PHRs from either an information or a technology perspective. Similar to TAM, the endogenous construct of this model is the Behavioral Intention to Use (PHR systems in this case). This construct captures an individual's expressed intent to use PHR technology in a model comprising several types of factors. In contrast to TAM, the model in this research does not include a Perceived Ease of Use factor. As Section 4 (Methodology) further explains, the research aimed at identifying principal factors of adoption of PHRs in general, preliminary to testing an actual PHR implementation. As potential users were not exposed to a PHR application and such a system was only described to them (in detail, though), they could not have an accurate perception of the usability features and, therefore, these features were not considered of interest in this study.

### 3.1 Information-Related Factors

Previous research has demonstrated that patients and other consumers use the Internet to gather information about a health condition or disease in order to improve their understanding of specific health topics [Bliemel & Hassanein 2007]. This suggests that individuals who use the Internet more for gathering health information will also have a higher acceptance of PHRs since these help to gather information and to monitor and record health status indicators. Moreover, it is also logically to assume that consumers with a higher level of knowledge about their health status will also value the importance of getting useful health-related information.

Higher patient satisfaction with the health care they receive has been found to result in more willingness to follow their physician's advice [Anderson et al. 2008; Sherbourne et al. 1992]. In addition, satisfaction with prior hospital experience affects expectations of future healthcare experiences [Bleich et al. 2009; John 1992]. Accordingly, the more satisfied consumers are with the previous care episodes they may have experienced without necessarily being chronically ill (e.g., visits with family doctor, routine lab tests, accidental hospital visits, etc.) the more receptive they are likely to be to newer eHealth support initiatives such as PHRs. Furthermore, consumers with positive impressions from past care episodes are more likely to appreciate the value of information in making the right decision about their health (e.g., visit a family doctor or an emergency room in a hospital when noticing an abnormal health parameter like very high blood pressure).

Consumer access to data sources regarding their own healthcare, through PHRs, is still controversial among healthcare providers. On one side, consumer control over access to their individual records may solve privacy and consent issues in existing medical systems, if consumers are given access to some of these data. In PHRs, individuals whose records are involved are delegated the responsibility of protecting their own confidentiality as this depends on

their consent. On the other side, health providers may still be reluctant to agree to this transfer of responsibility as suitable policies on personal data record privacy, security and control in general are still needed [Halamka et al. 2008]. Accordingly, it is important to develop an understanding of the implications of PHR access management [Archer & Fevrier-Thomas 2010] from a consumer viewpoint before developing full scale applications using these new artifacts. Nonetheless, it is logical to assume that consumer access to data sources of interest about their health will trigger the seeking of related information to get a better understanding of their respective medical conditions.

Although people typically do not want to make decisions about their healthcare, they do want to participate in these decisions and to be kept informed, in general [Johansen et al. 2012; Strull et al. 1984]. PHRs that gather data on an individual's medical condition and provide options for access to these data may fill that informational gap. Consequently, it is reasonable to believe that consumers with higher health-related information needs will also have a better understanding of the usefulness of PHRs in fulfilling (at least part of) these needs and, consequently, will be more inclined to adopt these newer healthcare IT artifacts.

Taking into account the above, the following hypotheses on information-related antecedents of PHR adoption intention are proposed:

*Hypothesis 1: Consumers with higher personal health knowledge will have a greater tendency to seek information about their health status.*

*Hypothesis 2: Consumers more satisfied with their current medical care will tend to be more interested in seeking information about their personal health information.*

*Hypothesis 3: Access to health data sources of interest to consumers will be linked to an increase in personal information seeking behavior.*

*Hypothesis 4a: Consumers with higher information-seeking preferences will tend to believe that PHRs are useful.*

*Hypothesis 4b: Consumers with higher information-seeking preferences will tend to be more likely to adopt PHRs.*

### 3.2 Technology-Related Factors

As the number of Internet users continues to increase, people are becoming more reliant on using this tool for information and communications on healthcare topics [Bliemel & Hassanein 2007; Tao et al. 2017]. Thus, in recent years the Internet has become an important channel for accessing healthcare information (and even receiving some medical consultations) [Zhang et al. 2017]. At the same time, more use of the Internet through various devices is expected to also increase user computer self-efficacy, i.e., ability to use a computer-related technology to fulfil a task [Compeau & Higgins 1995].

Personal information technology innovativeness may be another key construct when examining the acceptance of a PHR system. It conceptualizes a person's readiness to try out new IT in general [Agarwal & Prasad 1998]. It is, therefore, likely that people with higher readiness for IT will have higher levels of confidence in their computer-related skills (hence in their level of computer self-efficacy) [Ortiz de Guinea & Webster 2015]. People comfortable with the early adoption of an IT innovation can, very likely, better perceive the potential benefits of using that novel technology [Jackson et al. 2013], such as a PHR system. Furthermore, a higher level of computer self-efficacy increases user confidence with understanding the scope of an IT application and, consequently, enhances the perception of usefulness of that application [Ma & Liu 2005; Wang et al. 2015].

As expected for a sensitive area such as healthcare, privacy is an important issue in the use of interoperable health information systems [Weber-Jahnke & Obry 2012], including PHRs [Markle Foundation 2008]. Previous research has shown that most adult consumers are apprehensive about issues on the privacy and security of their health data [CHCF 2010]. However, according to the same research, consumers already using PHRs were less concerned about privacy implications of these systems. This finding is strengthened by other studies showing that people who have frequent healthcare needs (like the chronically and acutely ill) are less anxious about privacy in the medical system than are healthcare providers [Hassol et al. 2004; Walker et al. 2009]. Moreover, IS research has consistently demonstrated that having trust in a healthcare IT application makes potential users perceive the usefulness of that application and enhances adoption intention [Egea & González 2011; Tung et al. 2008]. Therefore, by combining the effect of decreased anxiety about healthcare IT security and privacy issues by people with recurrent healthcare needs and the effect of traction that trust in IT has on perceived usefulness and adoption, it is reasonable to assume that if people trust PHR services to protect security and privacy, they will find them useful and are more likely to use them.

A negative technology-related factor that may hinder adoption of PHRs is computer anxiety. This represents an apprehension related to the use of any computer [Simonson et al. 1987] because of personal characteristics (e.g., age, education, etc.) or past interactions with computers (e.g., training, experience, etc.) [Powell 2013]. This type of anxiety could understandably negatively affect intentions to use new IT applications [Venkatesh et al. 2003], including PHRs. Accordingly, the following hypotheses on technology-related antecedents of PHR adoption are proposed:

*Hypothesis 5: Individuals with higher Internet reliance will have a higher level of computer self-efficacy.*

*Hypothesis 6: Increased level of computer self-efficacy will result in higher levels of perceived usefulness of PHRs.*

*Hypothesis 7a: Individuals with higher levels of IT innovativeness will exhibit higher levels of computer self-efficacy.*
*Hypothesis 7b: Individuals with higher levels of IT innovativeness will perceive higher levels of usefulness for PHRs.*
*Hypothesis 8a: Trust in appropriate security and privacy levels of PHRs will positively affect user perceptions of PHR usefulness.*
*Hypothesis 8b: Trust in appropriate security and privacy levels of PHRs will positively affect user intentions to adopt PHRs.*
*Hypothesis 9: The level of computer anxiety of individuals will negatively affect their intention to use PHRs.*

3.3 Theoretical Model

The model this research proposes has Perceived Usefulness as the key antecedent of Behavioral Intention to Use PHRs. Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" [Davis 1989]. This construct, also associated with performance expectancy or extrinsic motivation, has consistently been the strongest predictor of Behavioral Intention to adopt an IT application in most empirical adoption studies [Venkatesh et al. 2003]. It is, therefore, expected to also play a strong role when assessing the adoption of a highly utilitarian healthcare IT application like PHRs. Consequently, the final hypothesis proposed is:

*Hypothesis 10: A higher perceived usefulness for PHRs will lead to a higher level of intention to adopt this technology.*

The theoretical model and associated hypotheses are shown in Figure 1.

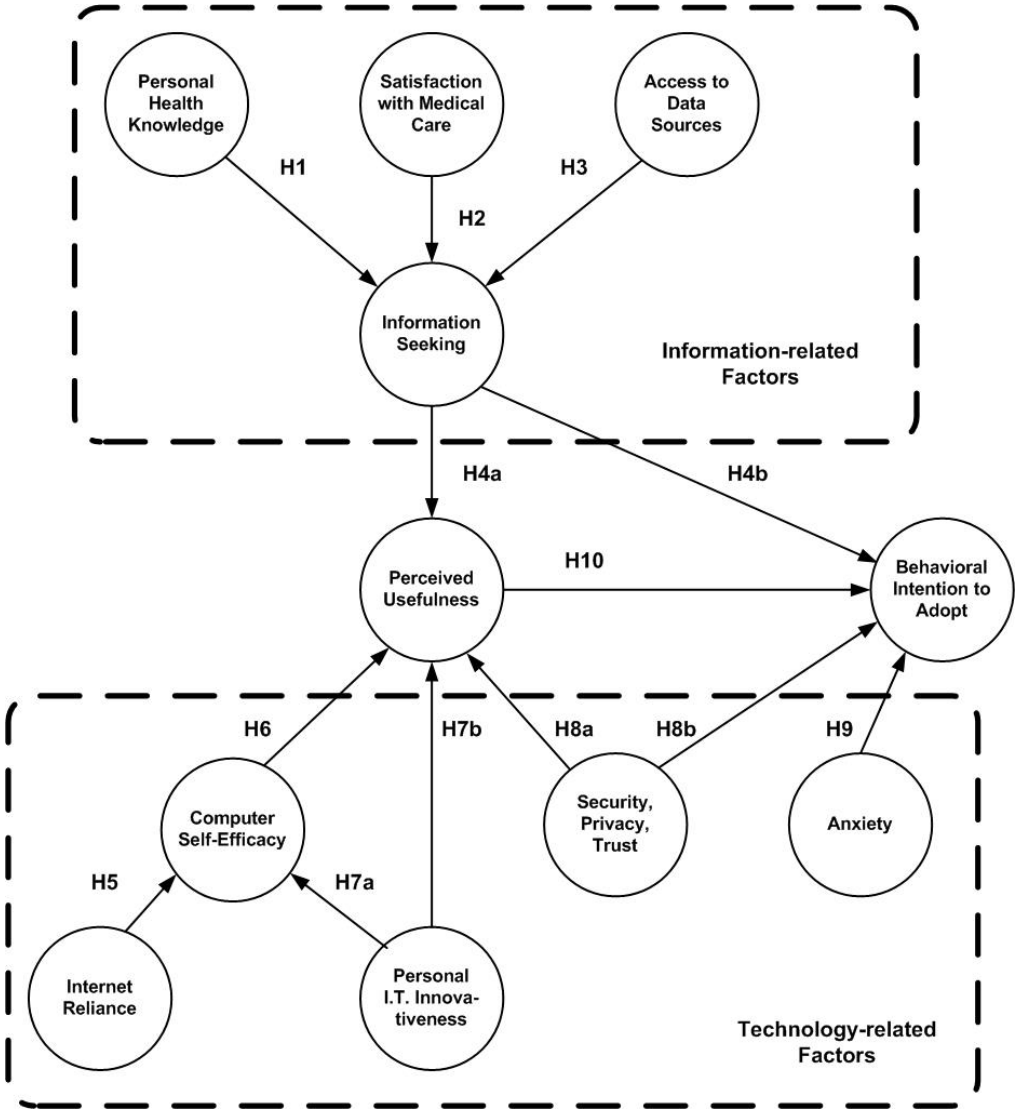


Figure 1: Theoretical Model and Hypotheses

## 4. Methods

The theoretical model and corresponding hypotheses were tested through an online questionnaire completed by a sample of 400 Canadian individuals. Both English and French versions of the survey instrument were developed. To ensure appropriate psychometric properties, items for most of the latent variables were adapted from validated measures reported in top publications in healthcare [Wilson & Lankton 2004] and IS research [Agarwal & Prasad 1998; Davis 1989; Venkatesh et al. 2003]. Items for the constructs Access to Data Sources together with Security & Privacy Trust were proposed and validated by this study. The latter was the only formative construct in the model, all of the others being reflective. Formative constructs manifest as a combination of their indicators in contrast to reflective constructs where the influence goes the other way – from a latent variable to its measurement scales. Responses were entered on 7-point Likert scales ranging from Strongly Disagree (1) to Strongly Agree (7) for each statement, with an additional Not Applicable choice. After being approved by a Canadian university's Research Ethics Board, the survey was pre-tested by graduate students of that university and pilot-tested with a sample of 45 individuals.

To ensure a suitable survey distribution, the main sample data were collected online Canada-wide, by a commercial firm, from a wide category of participants who had previously been enrolled by the firm and met the required including conditions (i.e., Internet users who were at least 18 years old and who declared not having a chronic illness or disability). Before taking the survey, a description was provided to participants explaining how PHRs work in principle without being required to test an actual PHR application. Data collected were part of a larger project conducted in that setting. A total of 383 valid cases remained after removing incomplete cases from the original sample of 400.

## 5. Results

Demographic characteristics of the final sample of 383 are shown in Table 1.

Table 1: Demographic Characteristics

| Characteristic | Findings |
|---|---|
| Age (average) | 46.5 |
| Gender | 57.7% Female, 42.3% Male |
| Maintain up-to-date PHRs on paper | 19.2%Yes, 80.8% No |
| Maintain up-to-date electronic PHRs | 5.8%Yes, 94.2% No |
| Number of visits with a doctor during past 6 months (average) | 2.3 |
| Number of doctors seen during past 6 months (average) | 1.4 |
| Number of children 12 years old or younger for whom they have main care responsibility at home (average) | 0.3 |
| The subject (or someone for whom they are responsible) has a chronic disease that requires continuing medical attention | 21.2%Yes, 78.8% No |
| The subject (or someone for whom they are responsible) has a disability that requires continuing care | 11.0%Yes, 89.0% No |
| Caring for elderly person(s) on a regular basis | 5.5%Yes, 94.5 % No |
| Interested in regularly maintaining records about health | 64.4%Yes, 35.6% No |
| Average amount of time spent using the Internet at home daily (largest two categories) | Between 31 and 60 minutes 58.0%, Between 11 and 30 minutes 29.0% |

Data analysis was performed with Partial Least Squares (PLS), as this Structural Equation Modeling technique is suitable for exploratory models [Bontis 1998], including those containing formative constructs [Thomas et al. 2005].

### 5.1 Measurement Model Evaluation

The measurement model was assessed with SmartPLS software [Ringle et al. 2005]. A first run of the program indicated the necessity to eliminate 5 items out of the total of 37 of the model due to poor significance levels or low item-to-construct loading values. After re-running the revised model the construct measures had the values indicated in Table 2. Item coding and respective questions are shown in Appendix A.

Table 2: Measurement Model

| Construct | Composite reliability (Cronbach's alpha; AVE) | Item | Mean | Standard deviation | Factor loading | Error |
|---|---|---|---|---|---|---|
| A | 0.937 (0.901; 0.833) | A1 | 3.614 | 1.724 | 0.933 | 0.033 |
| | | A2 | 3.946 | 1.844 | 0.845 | 0.064 |
| | | A3 | 3.462 | 1.684 | 0.957 | 0.012 |
| ADS | 0.863 (0.765; 0.680) | ADS1 | 6.120 | 1.067 | 0.861 | 0.057 |
| | | ADS2 | 5.843 | 1.206 | 0.887 | 0.058 |
| | | ADS3 | 5.659 | 1.427 | 0.714 | 0.108 |
| BI | 0.948 (0.917; 0.859) | BI1 | 5.134 | 1.513 | 0.965 | 0.010 |
| | | BI2 | 5.174 | 1.502 | 0.959 | 0.008 |
| | | BI3 | 4.574 | 1.685 | 0.853 | 0.043 |
| CSE | 0.888 (0.810; 0.726) | CSE1 | 5.234 | 1.461 | 0.800 | 0.076 |
| | | CSE2 | 5.640 | 1.345 | 0.854 | 0.060 |
| | | CSE3 | 5.461 | 1.363 | 0.900 | 0.031 |
| IR | 0.965 (0.945; 0.901) | IR1 | 6.153 | 1.450 | 0.925 | 0.094 |
| | | IR2 | 5.919 | 1.505 | 0.970 | 0.056 |
| | | IR3 | 5.819 | 1.576 | 0.952 | 0.037 |
| ISK | 0.915 (0.861; 0.782) | ISK1 | 6.291 | 0.868 | 0.868 | 0.060 |
| | | ISK2 | 6.298 | 0.972 | 0.891 | 0.036 |
| | | ISK3 | 6.479 | 0.871 | 0.895 | 0.034 |
| PHK | 0.958 (0.913; 0.919) | PHK1 | 5.372 | 1.233 | 0.968 | 0.051 |
| | | PHK2 | 5.377 | 1.181 | 0.949 | 0.102 |
| PITI | 0.956 (0.932; 0.879) | PITI1 | 4.394 | 1.677 | 0.957 | 0.017 |
| | | PITI2 | 3.955 | 1.773 | 0.910 | 0.026 |
| | | PITI3 | 4.850 | 1.627 | 0.944 | 0.013 |
| PU | 0.967 (0.957; 0.853) | PU1 | 5.536 | 1.284 | 0.928 | 0.020 |
| | | PU2 | 5.411 | 1.373 | 0.939 | 0.022 |
| | | PU3 | 5.594 | 1.361 | 0.919 | 0.026 |
| | | PU4 | 5.014 | 1.494 | 0.883 | 0.033 |
| | | PU5 | 5.457 | 1.373 | 0.947 | 0.015 |
| SMC | 0.964 (0.925; 0.930) | SMC1 | 5.189 | 1.398 | 0.962 | 0.188 |
| | | SMC2 | 5.212 | 1.403 | 0.967 | 0.214 |
| SPT | --- | SPT2 | 4.967 | 1.546 | 0.564 | 0.159 |
| | | SPT3 | 5.063 | 1.664 | 0.911 | 0.077 |

Abbreviations: A - Anxiety, ADS - Access to Data Sources, BI - Behavioral Intention to Adopt a PHR, CSE - Computer Self-Efficacy, IR - Internet Reliance, ISK - Information Seeking, PHK - Personal Health Knowledge, PITI - Personal IT Innovativeness, PU - Perceived Usefulness, SMC - Satisfaction with Medical Care, SPT - Security & Privacy Trust (1…5 = item number)

As Table 2 indicates, values for composite reliability, Cronbach's alpha, and Average Variance Extracted (AVE) are above 0.7, 0.7, and 0.5, respectively, for all reflective constructs. Further, their item loadings are above 0.7 and item errors are generally small. All items are significant at the 0.001 level or better. Accordingly, these results show appropriate reliability and convergent validity [Bontis 2004; Fornell & Larcker 1981].

A matrix displaying the square root of AVEs on the diagonal and correlations between reflective constructs off diagonal appears in Table 3. As diagonal elements are larger than corresponding off-diagonal ones, it can be concluded the measurement model has appropriate discriminant validity [Gefen & Straub 2005].

Table 3: Reflective Construct Correlations and Square Root of Construct AVEs

| | ADS | A | BI | CSE | ISK | IR | PU | PHK | PITI | SMC |
|---|---|---|---|---|---|---|---|---|---|---|
| ADS | 0.82 | | | | | | | | | |
| A | -0.18 | 0.91 | | | | | | | | |
| BI | 0.33 | -0.38 | 0.93 | | | | | | | |
| CSE | 0.47 | -0.19 | 0.33 | 0.85 | | | | | | |
| ISK | 0.41 | -0.13 | 0.23 | 0.29 | 0.88 | | | | | |
| IR | 0.26 | -0.14 | 0.20 | 0.36 | 0.25 | 0.95 | | | | |
| PU | 0.32 | -0.31 | 0.75 | 0.39 | 0.34 | 0.25 | 0.92 | | | |
| PHK | 0.15 | -0.08 | 0.07 | 0.15 | 0.24 | 0.18 | 0.08 | 0.96 | | |
| PITI | 0.20 | -0.16 | 0.38 | 0.32 | 0.03 | 0.30 | 0.42 | 0.11 | 0.94 | |
| SMC | 0.21 | -0.05 | 0.06 | 0.09 | 0.10 | 0.17 | 0.02 | 0.41 | 0.05 | 0.96 |

Abbreviations: A - Anxiety, ADS - Access to Data Sources, BI - Behavioral Intention to Adopt a PHR, CSE - Computer Self-Efficacy, IR - Internet Reliance, ISK - Information Seeking, PHK - Personal Health Knowledge, PITI - Personal IT Innovativeness, PU - Perceived Usefulness, SMC - Satisfaction with Medical Care

5.2 Structural Model Evaluation

Results of the structural evaluation of the model are captured in Figure 2.

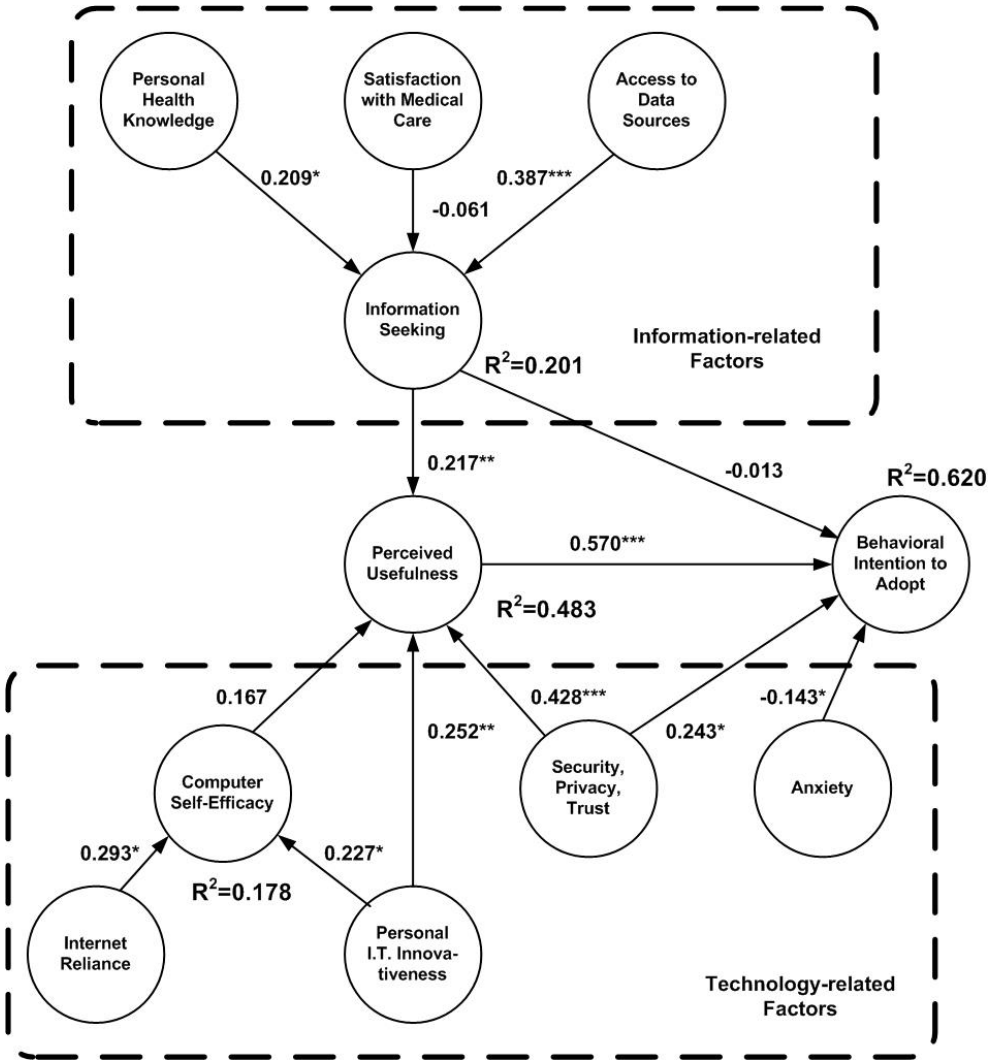


Figure 2: Results of Structural Evaluation. Significance Levels of Path Coefficients: *=0.05; ** = 0.01; *** = 0.001

Figure 2 shows that 10 out of the 13 hypotheses proposed were supported. As expected, Perceived Usefulness is the key antecedent of the intention to use PHRs, with a path coefficient of 0.57, significant at the 0.001 level. All demographic characteristics reported in Table 1 were tested as potential control variables but no significant effect on the endogenous constructs at a statistical level of 0.05 or better was detected. Total effects on the intention to use PHRs, for both information-related factors and technology-related factors, are shown in Table 4.

Table 4: Total Effects on Behavioral Intention

| | Coefficient | p-Value |
|---|---|---|
| ***Information-Related Factors*** | | |
| Personal Health Knowledge | 0.023 | 0.198 |
| Satisfaction with Medical Care | -0.007 | 0.627 |
| Access to Data Sources | 0.043 | 0.203 |
| Information Seeking | 0.111 | 0.154 |
| ***Technology-Related Factors*** | | |
| Internet Reliance | 0.028 | 0.206 |
| Computer Self-Efficacy | 0.095 | 0.112 |
| Personal IT Innovativeness | 0.165 | 0.014 |
| Security & Privacy Trust | 0.487 | 0.000 |
| Anxiety | -0.143 | 0.046 |

## 6. Discussion and Conclusions

The research question we asked in this study was: *What are the key information-related and technology-related factors that influence consumer perceptions of the adoption of Personal Health Record systems?* Answering this research question provided an opportunity to offer significant contributions to both research and practice, as explained below.

### 6.1 Theoretical Contributions

This study makes four key theoretical contributions to research. First, we constructed a theoretical model to explain the potential adoption of electronic personal health records (PHRs) by healthy individuals. The model was built upon the foundation of the Technology Acceptance Model (TAM) [Davis 1989; Davis et al. 1989] and has as its central innovative contribution the addition of two categories of antecedents (*information-related* and *technology-related*) specific to the adoption of PHRs. These antecedents were adapted from the healthcare and IS literatures and relied on theoretical reasoning regarding the main purpose of using PHRs by consumers (i.e., for information needs) and the skills individuals would need to have for using PHRs (i.e., from a technology point of view). The model was tested empirically with 383 Canadian consumers and was deemed empirically valid since the majority of the hypotheses were supported and *R-square* values of all the endogenous variables were moderately high for IS domain research (between 0.18 and 0.62, as shown in Figure 2) [Bontis et al. 2000].

Second, we found that, perhaps surprisingly, Information Seeking has no direct effect on the intention to use PHRs although the key rationale for using these applications should be informational. This may imply that consumers, i.e., people being generally healthy, are not so concerned about gathering information on health conditions or diseases. However, when people do want to seek such information, they would be favorable to using PHRs because they see the usefulness of these systems in finding relevant health information, as a visual inspection of Figure 2 indicates. This stresses the utilitarian role of these healthcare IT artifacts from the perspective of their potential healthy users. Indeed, similarly to popular technology adoption research in IS [Venkatesh et al. 2002; Venkatesh et al. 2003], we found Perceived Usefulness to be the single most important antecedent to the intention to use PHRs (path coefficient 0.570, significant at a 0.001 level in Figure 2).

Third, the premise according to which consumers with positive experience from past care episodes would appreciate the value of information in making the right decision about their health (e.g., see a family doctor when noticing something abnormal) was not supported. This may mean that isolated care incidents are, very likely, not significant for generally healthy people and do not influence their openness to PHRs' use (but the situation may change for chronically ill patients needing continuous care).

Fourth, in contrast to most adoption research in IS that has been looking exclusively at factors favoring the acceptance of IT artifacts, this study sought a more balanced view by also including possible deterrents, captured as a technology-related factor expressing computer anxiety. As expected from theoretical thinking and previous knowledge [Venkatesh et al. 2003], this factor proved to have a negative significant influence - the more anxious consumers are about computer technology use the less inclined they are to adopt PHRs.

### 6.2 Practical Contributions

The key practical contribution of this study is to indicate to those responsible for developing, implementing and operating PHRs for healthy individuals the most important adoption factors from the consumers' viewpoint. Total effect influences on behavioral intention and their significance levels captured in Table 4 support the conclusion that *technology factors are more important than information factors in the adoption equation of PHRs*. Therefore, efforts to increase the implementation success of these healthcare IT artifacts for consumers should address technology perceptions first.

Of the technology-related factors, as expected for a sensitive field like healthcare, Security & Privacy Trust is of the highest importance (total effect coefficient of 0.487, significant at the 0.001 level) followed by Personal IT Innovativeness and Anxiety (both significant at the 0.05 level, and having path coefficients of 0.165 and of -0.143, respectively). Although we assumed that a higher level of computer self-efficacy increases user understanding of the scope of PHRs and, consequently, people perception of their usefulness, this was not confirmed by the findings. A possible explanation comes from Table 1 that shows that an overwhelming proportion of the study participants have been using the Internet at home daily hence they should have at least some computer skills. Consequently, computer self-efficacy perceived by most of the participants was relatively high (i.e., did not vary considerably) and, therefore, could not influence significantly people's intention to adopt a PHR system. Therefore, based on the statistical results in Figure 2 and Table 4, to increase the chances of successful adoption of PHRs among healthy consumers, confidence in ensuring an appropriate level of security and privacy of the new IT should be reinforced, and sources of anxiety about using a new computer technology should be mitigated in some way.

Although comparatively less important than consumer views on PHR technology, information-related factors play a non-negligible role, albeit as drivers of usefulness perception only. Thus, Table 4 does not show any significant total effect of information-related perceptions on the intention to use PHRs but Figure 2 demonstrates that consumer preference for information seeking influences the usefulness they see in these newer healthcare IT artifacts (path coefficient of 0.217, significant at the 0.01 level). Moreover, Figure 2 also shows that consumer level of information seeking preference is determined by how knowledgeable people are about their health (path coefficient of 0.209, significant at the 0.05 level) and by how easy they can access health data sources of interest to them (path coefficient of 0.387, significant at the 0.001 level).

Overall, perceived usefulness having as antecedents the technology-related factors together with information-related factors included in this study explained 62% of the intention to adopt PHRs by potential users who are not also patients, as Figure 2 shows. This is considered to be a moderate to high explanatory power in IS research [Moon & Kim 2001].

### 6.3 Limitations and Future Research

As with virtually any empirical research on IT adoption, this study had limitations. Participants were pre-recruited by a survey company and self-selected following the invitation of that company. However, they were recruited country-wide, giving a sample that reflected a cross-section of Canadian Internet users.

The actual medical condition of the participants was unknown since this was self-reported and not based on medical evidence. Although participants were supposed to enroll only if not having a chronic illness or disability, survey demographics did not confirm this condition 100%. However, even though self-reporting health status involves a degree of subjectivity, participants in the sample were, indeed, more consumers than patients: the majority of them did not report having a chronic disease (78.8%), and were not caregivers for person(s) with disabilities (89%) or elderly person(s) (94.5%). Even if a small percent of subjects reported providing care for other persons with health problems (as shown in Table 1), this did not influence the statistical results significantly as all the control variable tests indicated. Future research should try to recruit participants confirmed by medical practitioners as being generally well and compare their perceptions about PHRs to those of actual chronically ill patients.

On the other hand, participants in the current study were experienced with computers and the Internet (58% of them spending between 31 and 60 minutes online at home daily). It would, therefore, be expected that they would be more accepting users of computers and IT in general. Future research should attempt to investigate perceptions of PHRs by people that are less computer-savvy.

In addition, we found that 94.2% of participants do not currently maintain electronic health records and, hence, might not appreciate their value. However, this situation is likely to change in the future as the awareness of PHRs increases. We concluded that, broadly, these types of limitations are not uncommon to IS and health informatics research and were considered reasonable for a new study in a sensitive field.

Overall, the research reported here was a scientific investigation on the adoption of PHRs that are gaining increased attention in today's healthcare environment. The study opens the door for further explorations and comparisons with other samples, including patients needing continuous medical care, to better understand perceived views of PHR systems and their potential for supporting better care, possibly at lower cost to society. This study found

that technology factors are more important than information factors in the consumer adoption of Personal Health Record systems despite the key informational purpose of these systems. Therefore, another possible path open by this study is to investigate whether technology-related factors are still more important than information-related factors in the adoption of IT innovations having primarily informational goals in other eCommerce domains.

## 7. Summary Points

What was already known on the topic of this study:

- Societal interest in Personal Health Record systems has gained momentum in recent years.
- Consumer perceptions and adoption decisions are key drivers of an information technology service success.
- There are both positive and negative factors of user adoption that may manifest in certain contexts.

What this study added to our knowledge:

- Adoption factors can be further divided into information-related and technology-related categories.
- Technology factors are more important than information factors in the consumer adoption of Personal Health Record systems.

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**Appendix A**

Measurement model item coding and survey questions

*Anxiety*

| | |
|---|---|
| A1 | I would feel apprehensive about using an Electronic Personal Health Record system. |
| A2 | It scares me to think that I could lose a lot of information using an Electronic Personal Health Record system by hitting the wrong key. |
| A3 | Using an Electronic Personal Health Record system would make me nervous. |

*Access to Data Sources*

| | |
|---|---|
| ADS1 | I believe that patients should have access to certain information about them from their physicians' records, as approved by their physicians. |
| ADS2 | I believe that physicians should have access to certain information that patients enter into their own Personal Health Record, as approved by their patients. |
| ADS3 | I believe that physicians should have access to ALL information that patients enter into their own Personal Health Record, as approved by their patients. |

*Behavioral Intention to Adopt an electronic personal health record system*

| | |
|---|---|
| BI1 | If an Electronic Personal Health Record system is made available for me, I intend to use it. |
| BI2 | If an Electronic Personal Health Record system is made available for me, I predict that I would use it. |
| BI3 | If an Electronic Personal Health Record system is made available for me, I intend to work together with my spouse or other caregiver(s) to use it on my behalf. |

*Computer Self-Efficacy*

I believe I could complete a job or task using an electronic personal health record system (ePHR):

| | |
|---|---|
| CSE1 | If there was no one around to tell me what to do as I proceed. |
| CSE2 | If I could call someone for help if I got stuck. |
| CSE3 | If I had just the built-in help facility for assistance. |

*Internet Reliance*

| | |
|---|---|
| IR1 | Having access to the Internet is important to me. |
| IR2 | The ability to communicate via the Internet is important to me. |
| IR3 | I communicate frequently via the Internet. |

*Information Seeking*

| | |
|---|---|
| ISK1 | I believe that doctors should explain the purpose of laboratory and other tests. |
| ISK2 | I believe that the results of laboratory and other tests should be made available to patients. |
| ISK3 | I believe that people should know all the important side effects of their medications. |

*Personal Health Knowledge*

| | |
|---|---|
| PHK1 | I am knowledgeable regarding care for my health problems. |
| PHK2 | I understand my health problems and how to care for them. |

*Personal Information Technology Innovativeness*

| | |
|---|---|
| PITI1 | If I hear about a new information technology I look for ways to experiment with it. |
| PITI2 | Among my friends I am usually the first to try out new information technologies. |
| PITI3 | In general, I am eager to try out new information technologies. |

*Perceived Usefulness*

| | |
|---|---|
| PU1 | Using my own Electronic Personal Health Records would help to support critical aspects of my health care such as scheduling appointments, recording my health status, etc. |
| PU2 | Using my own Electronic Personal Health Records would enhance my effectiveness in managing my own health care, such as managing medications, reviewing my progress, etc. |
| PU3 | Using my own Electronic Personal Health Records would make me more effective in providing up-to-date health information about myself when interacting with my physician. |
| PU4 | Using my own Electronic Personal Health Records would help to improve my health. |
| PU5 | Overall, having my own Electronic Personal Health Record system would be useful in managing my health care. |

*Satisfaction with Medical Care*

| | |
|---|---|
| SMC1 | I am satisfied with the medical care that I receive. |
| SMC2 | All things considered, the medical care that I receive is excellent. |

*Security & Privacy Trust*

From a security and privacy perspective I would prefer to maintain up-to-date electronic personal health records on a system that:

| | |
|---|---|
| SPT2 | Ran strictly on my own personal computer, with provision to take the records with me on a secure memory device, such as a smart card, as needed. |
| SPT3 | Is accessible through a secure Internet web site that is maintained by the provincial government's health authority. |