Consumer Perceptions of the Adoption of Electronic Personal Health Records: An Empirical Investigation

Mihail Cocosila  
*School of Business, Athabasca University, Athabasca, AB, Canada.*, mihailc@athabascau.ca

Norman Archer  
*DeGroote School of Business, McMaster University, Hamilton, ON, Canada.*, archer@mcmaster.ca

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Consumer Perceptions of the Adoption of Electronic Personal Health Records: An Empirical Investigation

Mihail Cocosila  
Athabasca University  
mihailc@athabascau.ca

Norm Archer  
McMaster University  
archer@mcmaster.ca

ABSTRACT
This study reports on an empirical investigation of consumer perceptions on the adoption of electronic Personal Health Record (PHR) systems. Encouraging people to monitor their own health and to record data in online PHRs is one approach which can help to improve the provision of care, while saving costs. A cross-sectional survey conducted among Canadian consumers revealed that perceptions of usefulness and personal information technology innovativeness are the main factors that encourage people to use electronic PHRs, while information-seeking factors are comparatively less important. Overall, the study opens the door for further investigations of potential user views on PHRs in an effort to understand the factors that would maximize the success of this new artifact in the highly sensitive social area of healthcare.

Keywords
Personal Health Records, information technology, adoption, acceptance, survey, Canada.

INTRODUCTION
Contemporary society is facing unprecedented pressures to provide better but also cost-effective care to an aging population that is affected by multiple health problems. One approach towards meeting these demands is to encourage the support of healthcare Information Technology (IT) tools that can provide relevant information efficiently at the point of care. 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. While these systems can help care providers to make informed decisions about their patients, a relatively newer approach is to encourage patients and general public to keep and use their own health records for health self management.

Personal Health Records (PHRs) tend to mirror EMRs or EHRs except that these newer electronic records are maintained by people monitoring their own health. PHRs can empower patients and move them from a role as passive recipients of healthcare services, to an active role in which they are informed, have choices, and are involved in the decision-making process (Demiris, Afrin, Speedie, Courtney, Sondhi, Vimarlund, Lovis, Goossen and Lynch, 2008). Ideally, PHRs facilitate timely and cost-effective access to information about individual healthcare history and topics that relate specifically to diseases or conditions.

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 money. 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 ultimate success of its use (Venkatesh, Speier and Morris, 2002). Investigating user perceptions and intentions to use electronic PHRs is of outmost importance in a sensitive sector like healthcare, where specific motivators for the use of new IT applications are expected to manifest.

A limited review of the topic “electronic personal health record(s)” and “user perceptions” found relatively few papers on this subject. To fill this knowledge gap, we undertook an empirical investigation of a sample of 383 Canadian consumers with the objective of developing a preliminary understanding of the perceptions of the Canadian population about the potential for adoption of PHRs. This paper reports on that research as follows: the next two sections describe the theoretical background and a theoretical research model we proposed. Following this are sections that present the methodological approach, the main results, and discussion and conclusions.
THEORETICAL BACKGROUND

Personal Health Record systems are gaining increased popularity in today’s society for several reasons. First is the current worldwide tendency to move toward patient-centred healthcare. This approach implies engaging patients in monitoring and managing their own healthcare, with potentially better outcomes and lower costs for themselves, healthcare systems and society (Demiris et al. 2008). Patient self-management of healthcare would be difficult without a tool to 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, thus avoiding permanent institutionalization. This tendency is driven by the need to provide better care with reasonable costs to an aging population that has a higher incidence of chronic illnesses (Eysenbach 2000; Watari, Wetherell, Gatz, Delaney, Ladd and Cherry, 2006). Providing ambulatory care to patients effectively requires, among other things, to keep track of patient history and interventions through PHR system support.

A third reason for the increasing popularity of PHRs is that access to the Internet and other media tools have 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 and Hassanein, 2007). To achieve all these goals requires monitoring health status through tools such as PHRs.

Although paper-based PHRs have been used in the past, virtually all modern PHRs are in electronic format and accessible online. This parallels the increasing use of Electronic Health Records (EHR) systems by physicians and healthcare institutions. EHRs are “a repository of information in computer-processable form that is employed by a physician to record and access information regarding the health of a patient” (Archer and Cocosila, 2011) and are becoming mandatory in today’s provision of medical care. Thus, to be fully beneficial, PHRs should exchange useful information with EHRs, allowing health professionals to make timely and documented interventions. The use of electronic PHRs has become possible due to the increasing popularity of various computing devices with Internet access capabilities (ranging from desktop personal computers to mobile phones) as well as to the increased skills of the general population in handling these devices. The focus of this paper is on electronic PHRs only and the term PHR will refer both to personal electronic records and the information systems used to support them.

As mentioned above, there are apparent advantages of PHRs for all major stakeholders in healthcare, including the general public. It is well-known in information systems research, that investigating factors of adoption of new information technologies or applications through various theories and models has been a traditional area of study (Venkatesh et al. 2002), as user views are an essential factor for the success of any IT innovation. Such an investigation is even more appropriate for a sensitive sector such as healthcare, which has significant implications for society.

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 key ingredient for PHRs. That is, people will use them if they perceive their usefulness in helping to maintain a healthy life. In addition to this, theoretical reasoning and previous research on the use of IT applications in healthcare indicate two broad categories of factors that would influence user adoption of PHRs:

- information-related (or ‘soft’) factors - e.g., people would use the applications because they need to be informed and also know what type of information they need, and
- technology-related (or ‘hard’) factors - e.g., individuals would use the applications because they have the skills and confidence to use the necessary technology.

Based on the above, in order to understand the main factors influencing PHR adoption from the perspective of consumers, this study proposes the following research question:

What are the key information-related and technology-related factors that influence consumer perceptions of the adoption of electronic Personal Health Record systems?

RESEARCH MODEL DEVELOPMENT

To investigate user 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). Potential constructs were added that could affect consumer intentions to adopt PHRs from, either an information or a technology perspective. As in well-known IT adoption research (Venkatesh, Morris, Davis and Davis, 2003), the endogenous construct
of this model is the Behavioral Intention to Use PHR systems. This captures an individual’s expressed intent to use the PHR technology in a model comprising several types of factors.

**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 and Hassanein, 2007). This suggests that patients who use the Internet more for gathering health information will also have a higher acceptance of PHRs since these systems also help to gather information and to monitor and record health status indicators.

Studies have also shown that patient satisfaction with healthcare will lead to more willingness to follow the physician’s advice (Sherbourne, Hays, Ordway, DiMatteo and Kravitz, 1992). Satisfaction with prior hospital experience also tends to influence expectations of future experiences (John, 1992). These findings are an indication that patients more satisfied with their current medical care will tend to be more receptive to additional eHealth support offerings such as PHRs.

Access to data sources that are related to individual patient healthcare, through PHRs, is subject to debate among healthcare providers. One benefit to providers is that patient control over access to their own records may solve privacy and consent issues the existing system faces when providing patients some of those data. In this manner, protecting patient confidentiality becomes the personal responsibility of the patient whose records are involved, since it revolves around the consent of the patient. PHRs that share data among patients and providers have been already successfully deployed. However, it is essential that care be taken in these cases to develop suitable policies to manage privacy, security, data stewardship and personal record control (Halamka, Mandl and Tang, 2008). Although previous studies found that consumers would be interested in accessing their PHRs (Archer and Fvrier-Thomas, 2010), it is important to develop an understanding of the implications of access management.

Although patients typically do not want to make their own decisions about their healthcare, they do want to be kept informed. A significant percentage of patients with chronic conditions would prefer to have received more information from their healthcare providers than they actually did (Strull, Lo and Charles, 1984). eHealth technologies such as the Internet, and PHRs that gather information specific to the individual’s status, provide enhanced methods of accessing that information. It is, therefore, likely that patients with higher information seeking preferences will be more inclined to accept PHRs.

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

\[ H_1: \text{Consumers with higher personal health knowledge will have a greater tendency to seek information about their health status.} \]

\[ H_2: \text{Consumers more satisfied with their current medical care will tend to be interested in seeking information about their personal health information.} \]

\[ H_3: \text{Access to health data sources of interest to consumers will be linked to an increase in personal information seeking behavior.} \]

\[ H_{4a}: \text{Consumers with higher information-seeking preferences will tend to believe that PHRs are useful.} \]

\[ H_{4b}: \text{Consumers with higher information-seeking preferences will tend to be more likely to adopt PHRs.} \]

**Technology-Related Factors**

As the number of consumers with Internet access continues to increase, people are becoming more reliant on the Internet for information and communications related to healthcare (Bliemel and Hassanein, 2007). At the same time this also increases their computer self-efficacy. Computer self-efficacy is defined as the judgment of one’s own ability to use a technology (e.g., computers, PHR systems, etc.) to accomplish a particular job or task (Compeau and Higgins, 1995). This ability can be very helpful in making use of PHR technology.

Personal Information Technology Innovativeness, defined as the willingness of an individual to try out any new IT (Agarwal and Prasad, 1998), is important for examining the concept of technology acceptance. Agarwal and Prasad (1998) suggest that personal innovativeness in information technology can be very useful in enriching a broad range of IT implementation models. It is likely that people exhibiting higher levels of IT innovativeness will be more interested in accepting PHRs since they will better perceive the usefulness of these systems. It is also very likely that people with higher levels of IT innovativeness will have higher levels of computer self-efficacy.
As expected for a sensitive area such as healthcare, privacy has been indicated in previous studies (e.g., (Markle_Foundation, 2008)) to be an important consideration in consumer PHR adoption. Two-thirds of adult consumers are concerned about the privacy and security of their health information, but consumers actually using a PHR are not particularly worried about its privacy implications (CHCF, 2010). The chronically and acutely ill and those who frequently use healthcare tend to be less concerned about privacy than are health professionals (Hassol et al. 2004; Walker et al. 2009). Trust in the providers of PHR services will play a positive role in their acceptance.

Computer anxiety is defined as an individual’s apprehension or fear when faced with the possibility of using a computer (Simonso, Maurer, Montag-Torardi and Whitaker, 1987). Venkatesh et al. (2003) found that computer anxiety has a direct negative influence on intention to use a new technology.

Accordingly, the following hypotheses on information-related antecedents of PHR adoption are proposed:

**H5:** Individuals with higher Internet reliance will have a higher level of computer self-efficacy.

**H6:** Increased level of computer self-efficacy will result in higher levels of perceived usefulness of PHRs.

**H7a:** Individuals with higher levels of IT innovativeness will exhibit higher levels of computer self-efficacy.

**H7b:** Individuals with higher levels of IT innovativeness will exhibit higher levels of perceived usefulness for PHRs.

**H8a:** Consumer perceptions of security, privacy, and trust in PHR providers will positively affect their perceptions of PHR usefulness.

**H8b:** Consumer perceptions of security, privacy, and trust in PHR providers will positively affect their intention to adopt PHRs.

**H9:** Level of computer anxiety will have a negative relationship with the intention to use PHRs.

**Theoretical Model**

The model this research proposes has Perceived Usefulness as the key antecedent of Behavioral Intention to use PHRs. Perceived usefulness is an extrinsic motivator for technology use that is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989). An equivalent terminology is performance expectancy. This construct is normally the strongest predictor of Behavioral Intention to adopt a technology in technology acceptance theories and models (Venkatesh et al. 2003). Consequently, the final hypothesis proposed is:

**H10:** 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 described in Figure 1.
METHODOLOGY

The theoretical model and corresponding hypotheses were tested through an online questionnaire completed by a sample of Canadian consumers. Both English and French versions of the survey instrument were developed. To ensure appropriate psychometric properties, questions measuring the items for most of the latent variables were adapted from measures reported in top publications in healthcare (Wilson and Lankton, 2004) and IS research (Agarwal and Prasad, 1998; Davis, 1989; Venkatesh et al. 2003). Questions for the constructs Access to Data Sources and Security, Privacy and Trust were proposed and validated by this study. The latter was the only formative construct in the model, all of the others being reflective. 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 consumers.

To ensure a suitable survey distribution, data were collected Canada-wide through an Internet panel, by a commercial firm, from a wide category of participants who had previously been enrolled by the firm and met the including conditions (i.e., Internet users who were at least 18 years old and not claiming to have a chronic illness). These data were part of a larger project conducted in that setting. For this study the total sample size was 400 participants. Participants were offered compensation through an online prize draw. A total of 383 valid cases remained after removing incomplete cases.

MAIN FINDINGS

Demographic characteristics of the sample are shown in Table 1.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (average)</td>
<td>46.5</td>
</tr>
<tr>
<td>Gender</td>
<td>57.7% Female, 42.3% Male</td>
</tr>
<tr>
<td>Maintain up-to-date PHRs on paper</td>
<td>19.2% Yes, 80.8% No</td>
</tr>
</tbody>
</table>
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) | 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%

Table 1. Demographic Characteristics

Data analysis was performed with Partial Least Squares (PLS) as this is suitable for exploratory models (Bontis, 1998), including those containing formative indicators (Thomas, Lu and Cedzynski, 2005) like the Security, Privacy and Trust construct proposed in this research.

Measurement Model Evaluation

The measurement model was assessed with SmartPLS (Ringle, Wende and Will, 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.
Table 2. Measurement Model

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 were significant at the 0.001 level or better. Accordingly, these results show appropriate reliability and convergent validity (Bontis, 2004; Fornell and Larcker, 1981).

The next test consisted of visually inspecting a matrix displaying the square root of AVEs on the diagonal and correlations between reflective constructs off diagonal (Table 3). As diagonal elements are larger than corresponding off-diagonal ones, it can be concluded the measurement model has appropriate discriminant validity (Gefen and Straub, 2005).
Table 3. Reflective Construct Correlations and Square Root of Corresponding AVEs

Structural Model Evaluation

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

![Figure 2. Results of Structural Evaluation. Significance levels: *=0.05; ** = 0.01; *** = 0.001](image)

Figure 2 shows that 9 out of the 12 hypotheses were supported. Since the majority of the hypotheses were confirmed and R-square values of the endogenous variables were moderately high for IS domain research (between 0.18 and 0.62), the theoretical model could be termed as being appropriate (Bontis, Keow and Richardson, 2000).

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. Total effects on the intention to use PHRs, for the information-related factors and technology-related factors, as calculated by SmartPLS, are shown in Table 4.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Coefficient</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Health Knowledge</td>
<td>0.023</td>
<td>0.198</td>
</tr>
<tr>
<td>Satisfaction with Medical Care</td>
<td>-0.007</td>
<td>0.627</td>
</tr>
<tr>
<td>Access to Data Sources</td>
<td>0.043</td>
<td>0.203</td>
</tr>
<tr>
<td>Information Seeking</td>
<td>0.111</td>
<td>0.154</td>
</tr>
<tr>
<td><strong>Technology Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet Reliance</td>
<td>0.028</td>
<td>0.206</td>
</tr>
</tbody>
</table>
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Table 4. Total Effects on Behavioral Intention

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total Effect</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Self-Efficacy</td>
<td>0.095</td>
<td>0.112</td>
</tr>
<tr>
<td>Personal IT Innovativeness</td>
<td>0.165</td>
<td>0.014</td>
</tr>
<tr>
<td>Security, Privacy and Trust</td>
<td>0.487</td>
<td>0.000</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-0.143</td>
<td>0.046</td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSIONS

The purpose of this paper has been to propose and validate a theoretical model to explain the adoption of electronic personal health records. A model sourced from the healthcare and IS literature as well as from theoretical reasoning was built and tested empirically with 383 Canadian participants.

The research question we asked was: What are the key information-related and technology-related factors that influence consumer perceptions of the adoption of electronic Personal Health Record systems? To answer this question, following the example of validated adoption research in IS (Venkatesh et al. 2002, Venkatesh et al. 2003), we proposed a number of factors in each category acting directly or indirectly (through Perceived Usefulness) on the Behavioral Intention to use this IT artifact. Similar to the above-mentioned research, we found Perceived Usefulness the single most important antecedent on the intention to use PHRs (path coefficient 0.570, significant at a 0.001 level).

A visual inspection of Figure 2 shows that, from the information point of view, people would use PHRs because they see the usefulness of these devices when seeking health information. While personal health knowledge and, especially, access to data sources reinforce the need to seek health information, satisfaction with medical care has no significant effect on this. Most of the technology factors have a significant positive role in the adoption equation (e.g., reliance on the Internet, personal innovativeness towards the use of IT, or perception of security, privacy and trust in PHRs). The only exception is that computer self-efficacy does not have a significant effect, contradicting previous research (Compeau and Higgins, 1995); this finding deserves, therefore, future attention. As expected, similar to previous research (Venkatesh et al. 2003), computer anxiety has a negative significant influence - the less anxious consumers are about computer use, the more inclined they are to adopt PHRs.

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. As expected for a sensitive field like healthcare, Security, Privacy and Trust is of outmost importance (total effect coefficient of 0.487, significant at a 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). A possible explanation of these findings is that the participants in the sample were more consumers than patients: the majority of them did not report having a chronic disease (78.8%), and did not care for a person with disabilities (89%) or an elderly person (94.5%). Therefore participants were unlikely to be concerned about seeking medical information. On the other hand, they seemed to be fairly experienced with the Internet (58% of them spending between 31 and 60 minutes online at home daily) and, thus, with computers and IT in general.

As with virtually any empirical research on IT adoption, this study had limitations. Participants were pre-recruited by the survey company and self-selected following the invitation of that company. However, they were recruited Canada-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 (e.g., having a chronic illness or not) and not based on medical evidence. Also, the number of participants who do not currently maintain health records and, hence, might not appreciate their value in an electronic format, is relatively high. However, these types of limitations are not uncommon to IS research and were considered reasonable for a new study in a sensitive field.

Overall, this was a scientific investigation on the adoption of an IT artifact that is gaining increased attention in today’s healthcare - electronic Personal Health Records. The study opens the door for further explorations and comparisons with other samples, including patients needing regular medical care, to better understand consumer views of PHR systems and their potential for supporting better care, possibly at lower cost to society.

REFERENCES


