

# **Consumer Adoption of Personal Health Records**

By

Armin Majedi

A thesis submitted to the

Faculty of Graduate and Postdoctoral Studies

in partial fulfilment of the degree requirements of

**Master of Science in Electronic Business Technologies**



University of Ottawa

Ottawa, Ontario, Canada

© Armin Majedi, Ottawa, Canada, 2014

## Abstract

Health information technology (HIT) aims to improve healthcare services by means of technological tools. Patient centered technologies such as personal health records are relatively new HIT tools that enable individuals to get involved in their health management activities. These tools enable the transformation of health consumer behavior from one of passive health information consumers to that of active managers of their health information. This new role is more interactive and engaged, and with such tools, patients can better navigate their lives, and exercise more control over their treatments, hence potentially also leading to improvement in the quality of health services. Despite the benefits of using personal health record systems for health consumers, the adoption rate of these systems remains low. Many free and paid services have not received the uptake that had been anticipated when these services were first introduced. This study investigates some factors that affect the adoption of these systems, and may shed light on some potential reasons for low adoption rates.

In developing the theoretical model of this study, social cognitive theory (SCT) and technology acceptance model (TAM) were utilized. The theoretical model was validated through a quantitative survey-based methodology, and the results were derived using structural equation modeling techniques.

The key findings of this study highlight the role of individual and environmental factors as determinants of end-user behavior in the adoption of personal health records. The results show that in addition to perceptions of usefulness and ease of use, factors such as social norms and technology awareness are also significantly associated with various factors that directly and indirectly affect intention to use PHRs

Based on the results obtained in this study, recommendations are offered for technology providers, and possible directions are proposed for academic researchers.

## Acknowledgments

Completing my Master's thesis has been riddled with many ups and downs which I shared with many wonderful people.

Foremost, I would like to express my deepest gratitude to Dr. Umar Ruhi. Despite having a heavy workload, he helped refine my research, and guided me throughout the duration of my studies with his critical and instructive comments. In addition, his immense knowledge and care about details were the key factors for successful completion of the work.

I have been blessed with a supportive family who always encouraged me in the challenging times. Without whom I could not have made it here. I appreciate wisdom of my father who is always my hero and role model. My greatest gratitude to my mother who her love and encouragements accompanied me thought out my way for following my dreams. I would like to thank my sister Maryam for her dedication and support in this project.

Finally, I would like to thank my fiancé, Sanaz, without her continued love, patience and support this work would not be completed.

## Table of Contents

|                                                                   |           |
|-------------------------------------------------------------------|-----------|
| Abstract .....                                                    | 2         |
| Acknowledgments .....                                             | 3         |
| List of Tables.....                                               | 7         |
| <b>1.0 Introduction</b> .....                                     | <b>9</b>  |
| 1.1 Research Rationale .....                                      | 11        |
| 1.2 Conceptual Framework .....                                    | 12        |
| 1.2.1 Individual Factors .....                                    | 14        |
| 1.2.2 Environmental factors .....                                 | 14        |
| 1.3 Research Question .....                                       | 15        |
| 1.3.1 General Research Question.....                              | 15        |
| 1.3.2 Specific Research Questions.....                            | 15        |
| 1.4 The Structure of the Thesis.....                              | 15        |
| <b>2.0 Literature Review</b> .....                                | <b>16</b> |
| 2.1 Consumer Health Informatics.....                              | 16        |
| 2.1.1 CHI Evolution and Vision.....                               | 16        |
| 2.1.2 Health information Infrastructure requirements for CHI..... | 17        |
| 2.1.3 Health Information Consumer Behavior .....                  | 18        |
| 2.1.4 CHI Adoption Challenges.....                                | 19        |
| 2.1.5 CHI Future Goals.....                                       | 21        |
| 2.2 Positive Technologies in Patient Healthcare .....             | 21        |
| 2.3 Patient-Facing Information Systems (PFIS) .....               | 25        |
| 2.3.1 Consumer Perspective .....                                  | 25        |
| 2.3.2 Physician Perspective.....                                  | 26        |
| 2.4 Personal Health Records .....                                 | 27        |
| 2.4.1 PHRs definition.....                                        | 27        |
| 2.4.2 PHRs History .....                                          | 29        |
| 2.4.3 PHRs Goals, Types, Architectures .....                      | 30        |
| 2.4.4 Types of PHRs Services .....                                | 33        |
| 2.4.5 Mobile PHRs and PHR Portals .....                           | 36        |
| 2.4.6 PHRs Stakeholders and Value Proposition .....               | 39        |
| 2.4.7 PHR Case Study: Blue Button Initiative .....                | 41        |

|                                                                                       |           |
|---------------------------------------------------------------------------------------|-----------|
| 2.5 Consumer Adoption Factors for PHRs .....                                          | 43        |
| 2.5.1 PHRs Impact on Consumer Healthcare.....                                         | 43        |
| 2.5.2 Adoption Barriers and Drivers .....                                             | 43        |
| 2.5.3 Chronic Illnesses (Niche Market and Early Adaptors) .....                       | 45        |
| 2.6 PHRs Use Cases.....                                                               | 46        |
| 2.6.1 Chronic Condition .....                                                         | 46        |
| 2.6.2 Remote Patient Monitoring .....                                                 | 47        |
| 2.6.3 Maintain Medical History (e.g. emergency) .....                                 | 48        |
| 2.6.4 Personal Health Diary.....                                                      | 49        |
| 2.6.5 Inherited Disease Monitoring and Prevention .....                               | 49        |
| 2.7 Physicians' Acceptance of PHRs.....                                               | 51        |
| 2.7.1 PHRs Impacts on Physicians' Services .....                                      | 51        |
| 2.7.2 Physicians' Adoption Factors.....                                               | 52        |
| 2.7.3 Integration Challenges .....                                                    | 54        |
| <b>3.0 Research Design and Methodology.....</b>                                       | <b>55</b> |
| 3.1 Theories Used in Formation of the Research Theoretical Model .....                | 55        |
| 3.1.1 Technology Acceptance Model (TAM) .....                                         | 55        |
| 3.1.2 Social Cognitive Theory (SCT) .....                                             | 57        |
| 3.2 Research Proposed Theoretical Model .....                                         | 60        |
| 3.2.1 Proposed Constructs' Dimensions and Paths.....                                  | 61        |
| 3.3 Research Design and Method Appropriateness .....                                  | 63        |
| 3.4 Survey Instrument Design and Data Collection.....                                 | 63        |
| 3.4.1 Construct Measurement Items.....                                                | 64        |
| 3.4.2 Design Consideration and Validity of the Survey .....                           | 66        |
| 3.4.3 Survey Pre-Test Procedure .....                                                 | 66        |
| 3.5 Data Collection and Survey Administration Procedures .....                        | 67        |
| 3.5.1 Sampling Frame .....                                                            | 67        |
| 3.5.2 Sample Size Requirement .....                                                   | 67        |
| 3.6 Data Analysis and Reporting Procedures.....                                       | 68        |
| 3.6.1 Demographic and Technographic Analysis and Reporting .....                      | 68        |
| 3.6.2 Exploratory Factor Analysis (Measurement Validity and Construct Dimensionality) |           |
| .....                                                                                 | 68        |
| 3.6.3 Structural Equation Modeling Analysis of Theoretical Model.....                 | 69        |

|                                                                 |            |
|-----------------------------------------------------------------|------------|
| 3.7 Restructuring the Theoretical Model .....                   | 72         |
| <b>4.0 Data Analysis and Results .....</b>                      | <b>73</b>  |
| 4.1 Participant Characteristics and Descriptive Statistics..... | 73         |
| 4.2 Research Proposed Structural Model Validation.....          | 76         |
| 4.3 Structural Equation Modeling Analysis .....                 | 76         |
| 4.3.1 Evaluation of the Measurement Model.....                  | 76         |
| 4.4 Open Ended Question.....                                    | 83         |
| <b>5.0 Discussion and Conclusion.....</b>                       | <b>85</b>  |
| 5.1 Structural Model Validity.....                              | 85         |
| 5.1.1 Individual Layer .....                                    | 86         |
| 5.1.2 Environmental Layer .....                                 | 91         |
| 5.1.3 Technology Acceptance Factors.....                        | 93         |
| 5.2 Theoretical and Practical Contributions .....               | 95         |
| 5.2.1 Contributions to Theory .....                             | 95         |
| 5.2.2. Contributions to Practice.....                           | 96         |
| 5.3 Study Limitations.....                                      | 100        |
| 5.3.1 Limitations in the survey methodology.....                | 100        |
| 5.3.2 Generalizability of the results.....                      | 101        |
| 5.3.3 Survey participants.....                                  | 101        |
| 5.4 Suggestions for Future Studies.....                         | 102        |
| 5.5 Conclusion.....                                             | 103        |
| <b>6.0 Bibliography.....</b>                                    | <b>104</b> |

## List of Tables

|                                                                                   |    |
|-----------------------------------------------------------------------------------|----|
| TABLE 1: CONCEPTUAL FRAMEWORK AND ITS COMPONENTS.....                             | 13 |
| TABLE 2: HEALTH INFORMATION CONSUMERS.....                                        | 18 |
| TABLE 3: PHRS EVOLVING DEFINITIONS .....                                          | 28 |
| TABLE 4: DATA ELEMENTS TO COMPLETE THE PATIENT PROFILE .....                      | 31 |
| TABLE 5: PHRS REVENUE MODEL .....                                                 | 35 |
| TABLE 6: PHRS MOBILE AND PORTALS .....                                            | 37 |
| TABLE 7: PHRS STAKEHOLDERS AND VALUE PROPOSITIONS.....                            | 40 |
| TABLE 8: PHRS USE CASES .....                                                     | 50 |
| TABLE 9: PATH PROPOSITIONS AND VALIDATIONS (INDIVIDUAL FACTORS) .....             | 61 |
| TABLE 10: PATH PROPOSITIONS AND VALIDATIONS (TECHNICAL FACTORS) .....             | 61 |
| TABLE 11: PATH PROPOSITIONS AND VALIDATIONS (ORGANIZATIONAL FACTORS) .....        | 62 |
| TABLE 12: PATH PROPOSITIONS AND VALIDATIONS (TECHNOLOGY ACCEPTANCE FACTORS) ..... | 62 |
| TABLE 13: NATURE OF MEASUREMENT .....                                             | 64 |
| TABLE 14: MEASUREMENT ITEMS FOR MODEL CONSTRUCTS .....                            | 65 |
| TABLE 15: EVALUATION OF MEASUREMENT MODEL RELIABILITY AND VALIDITY.....           | 70 |
| TABLE 16: EVALUATION OF MEASUREMENT MODEL RELIABILITY AND VALIDITY.....           | 71 |
| TABLE 17: PATH PROPOSITIONS AND VALIDATIONS (MODIFIED PATHS) .....                | 72 |
| TABLE 18: MATRIX OF LOADING AND CROSS LOADINGS .....                              | 77 |
| TABLE 19: AVERAGE VARIANCE EXTRACTED AND INTER-CONSTRUCT CORRELATIONS.....        | 78 |
| TABLE 20: CONSTRUCTS STATISTICS – CONVERGENT VALIDITY .....                       | 79 |
| TABLE 21: CONSTRUCTS COEFFICIENTS OF DETERMINATION ( $R^2$ ) .....                | 79 |
| TABLE 22: COMBINED DATA PATH VALIDITY ANALYSIS .....                              | 81 |
| TABLE 23: EFFECT SIZES FOR THE ESTIMATED STRUCTURAL MODEL.....                    | 81 |
| TABLE 24: EFFECT SIZES FOR THE ESTIMATED STRUCTURAL MODEL RESULTS .....           | 82 |
| TABLE 25: CALCULATION OF THE GLOBAL CRITERION FOR GOODNESS-OF-FIT (GoF) .....     | 83 |
| TABLE 26: IMPORTANT FACTORS TO DETERMINE THE USER BEHAVIOR.....                   | 83 |
| TABLE 27: PATH1 PROPOSITIONS AND VALIDATIONS (INDIVIDUAL FACTORS) .....           | 86 |
| TABLE 28: PATH2 PROPOSITIONS AND VALIDATIONS (INDIVIDUAL FACTORS) .....           | 87 |
| TABLE 29: PATH3 PROPOSITIONS AND VALIDATIONS .....                                | 88 |
| TABLE 30: PATH7 PROPOSITIONS AND VALIDATIONS.....                                 | 89 |
| TABLE 31: PATH PROPOSITIONS AND VALIDATIONS (ORGANIZATIONAL FACTORS) PATHS .....  | 90 |
| TABLE 32: PATH PROPOSITIONS AND VALIDATIONS (TECHNICAL FACTORS) .....             | 91 |
| TABLE 33: PATH PROPOSITIONS AND VALIDATIONS (ORGANIZATIONAL FACTORS) PATHS .....  | 92 |
| TABLE 34: PATH PROPOSITIONS AND VALIDATIONS (TECHNOLOGY ACCEPTANCE FACTORS).....  | 93 |
| TABLE 35: PATH PROPOSITIONS AND VALIDATIONS (TECHNOLOGY ACCEPTANCE FACTORS).....  | 93 |
| TABLE 36: PATH PROPOSITIONS AND VALIDATIONS (TECHNOLOGY ACCEPTANCE FACTORS).....  | 94 |

## List of Figures

|                                                                                          |    |
|------------------------------------------------------------------------------------------|----|
| FIGURE 1: DOMAIN AREAS GUIDING THE DESIGN AND DEVELOPMENT OF POSITIVE TECHNOLOGIES ..... | 23 |
| FIGURE 2: PFIS FUNCTIONALITY FRAMEWORK (ADAPTED FROM AHERN ET AL., 2011) .....           | 25 |
| FIGURE 3: TECHNOLOGY ACCEPTANCE MODEL (TAM) .....                                        | 56 |
| FIGURE 4: SOCIAL COGNITIVE THEORY (SCT) COMPONENTS .....                                 | 57 |
| FIGURE 5: RESEARCH PROPOSED THEORETICAL MODEL .....                                      | 60 |
| FIGURE 6: THE REFINED THEORETICAL MODEL .....                                            | 72 |
| FIGURE 7: STATUS OF THE RESPONDENTS .....                                                | 73 |
| FIGURE 8: PHYSICIAN VISITS DURING THE LAST SIX MONTHS .....                              | 73 |
| FIGURE 9: MAINTAIN HEALTH INFORMATION .....                                              | 74 |
| FIGURE 10: THE MOST IMPORTANT HEALTHCARE ISSUES .....                                    | 74 |
| FIGURE 11: HOW MUCH EACH USECASE IS APPLICABLE .....                                     | 75 |
| FIGURE 12: USECASE APPLICABILITY .....                                                   | 75 |
| FIGURE 13: THE STRUCTURAL MODEL .....                                                    | 80 |
| FIGURE 14: STRUCTURAL MODEL VALIDITY .....                                               | 85 |

## 1.0 Introduction

In most countries across the globe, accessing health records and communicating through them with physicians is relatively difficult for patients (Popovich & Rose, 2012). Many potential value added activities such as getting a second opinion, real time access to medical information, communicating and managing health records poses many difficulties for health consumers. Enabling effective means for pursuing these activities can significantly save money for the escalating budget of health care system (Leighton, 1999). During the last five years, healthcare costs in Canada had a steady growing rate of around 4% and approximately contributed in 8% towards the national GDP (Levert, 2013).

There are a number of technologies that provide information technology capabilities for health consumers. Personal Health Records (PHRs) is one example of these technologies that enable individuals to control many activities related to the management of their health condition. PHRs are generally offered by private or public providers in the form of online or offline desktop or mobile-based platforms. The system stores different types of health information from multiple sources. If the users update their records regularly, they could receive many benefits by a more effective management over their conditions (Solomon, 2013). Due to the high value of the system to healthcare services, many health data aggregators have already offered personal health services to the public (e.g. MyOscar and myPHR.ca). In 2010, the Department of Veterans Affairs (VA) of the United States launched an initiative called “Blue Button” by which health consumers could have secure access to their health records. This feature empowers patients by providing more information, control and engagement in their self health management activities.

PHRs provide value to the healthcare services in many ways (PBGH, 2009). They improve the quality of care through centralizing the information in a single storage. The centralized information provides the patient with access to integrated health records from the corresponding institutions or offices in real time. As a result, duplications of tests are prevented and higher amount of information is accessible for health decision making. Moreover, PHRs saves the resources by offering different features such as schedule appointments, prescription refills and communication with physicians. The system assists the end users in monitoring daily self-care activities such as diet and enables them to collaborate on their common issues and share their experiences. It could automatically send the vital health indicators such as blood sugar to the physicians when the monitoring equipments are attached. Lastly, PHRs

empower individuals in taking care of their family members. It provides an organized platform in which the caregiver could control the medications or symptoms and communicate with physicians in the emergency cases.

Despite PHRs' huge potential value in health information management, the adoption rate of these systems is very low. Many barriers have been identified and discussed in the literature. These obstacles are associated with the physicians, patients and system itself. Due to the lack of financial intensive, low accuracy of the patient entered data and perceived loss of control over the health procedures, PHRs is not widely accepted among healthcare practitioners. As a result, they resist integrating their Electronic Health Records (EHRs) with the personal health systems. EHRs is "an information system that enable hospitals to store and retrieve detailed patient information to be used by health care providers (Silow-Carroll, Edwards, & Rodin, 2012).

Also, privacy concerns, lack of enough awareness and computer anxiety causes many individuals hesitate using the system. They still prefer to maintain their health records in physician offices or on paper (Shanholtzer, 2011). Furthermore, current personal health systems in the market do not comply with a specific standard and are not generally compatible with other sources of information such as EHRs.

This research is conducted for determining the barriers and drivers in using personal health systems. Towards this goal, an empirical model was developed, utilizing various constructs from tech adoption theories in the extant literature. This model is subsequently validated through a survey questionnaire.

## 1.1 Research Rationale

One of the reasons behind ineffectiveness of the Healthcare industry is lack of consolidated health records for the consumers. In a recent report, it was highlighted by Pew Internet Project's healthcare research that only 21% of the individuals use some form of technology to track their health data (Murray, Dimock, Mueller, Taylor, & Kohut, 2014). As stated by one medical provider, "This is a \$2.4 trillion industry run on handwritten notes" (Salter, 2009). With the ascending healthcare cost in the United States (from \$2,029.1 in 2005 to \$2,593.6 in 2010) (Sebelius, 2012), new healthcare management options and policies are being sought to improve the sector's performance and to deliver sustainable services (Canada Health Infoway, 2011).

This research study is situated within the field of Consumer Healthcare Informatics (CHI) and its capabilities of improving healthcare services. CHI programs are being adopted to develop IT-enabled healthcare environments that provide better cost effectiveness (Protti, 2007). Estimations show the high potential tangible and intangible benefits of information technology applicable to health management. Although some studies have provided important highlights for the successful implementation of CHI in healthcare (Holmes, 2013; Arocha and Hoffman, 2012; Demiris, 2012; Eyler, 2011), many suggest that more research needs to be done in this area (Gibbons et al., 2009; Shipman, Kurtz-Rossi, & Funk, 2009).

There are different provider-centric architectures and models of health management systems in physician offices, hospitals and other institutional health centers which have different goals and value propositions. Personal health systems have recently been promoted in Canada health strategic planning initiatives (Canada Health Infoway, 2011) due to their potential for delivering quality services in a cost effective manner (Smith, Odlum, Sikka, Bakken, & Kanter, 2012). Despite the benefits of PHRs being understood by end-users (Snowdon, Shell, & Leitch, 2010), the rate of user acceptance does not meet the Consumer Health Informatics' (CHIs) long term objectives which is to empower consumers by putting health information into their hands (Jha et al., 2009). Therefore, many studies have been done to assess the acceptance of PHRs by the end users, and more research in this area is suggested by the researchers (Cohn, 2006; Alkhatlan & Bachelor, 2010; Wilson & Peterson, 2010; Agarwal, Anderson, Zarate, & Ward, 2013).

In addition to the existing literature gaps, this study aims to addressing some factors for PHRs vendors and service providers for the design and delivery of the system. It also could help government and policy makers to minimize unnecessary redlines for PHRs providers and accelerate the system adoption by establishing rules and policies that motivate individuals to adopt the system.

According to a recent study by (Agarwal et al., 2013), factors influencing the adoption of personal health systems can be categorized into individual factors, technological factors and organizational factors. Agarwal also suggested that more effort needs to be done in determining the individual behavior towards using PHRs systems. This research aims to investigate these groups of factors to determine what individual and environmental constructs affect the consumer adoption of personal health record systems.

## **1.2 Conceptual Framework**

In order to study the environmental and individual factors affecting the use of patient facing information systems, a theoretical model is formulated from the two different theories: Social Cognitive Theory (SCT) and Technology Acceptance Model.

The major components of the conceptual framework are summarized in Table 1. Specifically, the table presents the constructs associated with each component, their definition and origin.

Table 1: Conceptual Framework and its Components

| <div><div>Individual Factors</div><div>Technology Acceptance</div><div>Environmental Factors</div></div> |                       |                        |                               |                                                                                                                                                                                |                         |
|----------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Adobted From                                                                                             | Component             |                        | Construct                     | Definition                                                                                                                                                                     | Source                  |
| Technology Acceptance Model (TAM)                                                                        |                       |                        | Perceive Ease of Use          | The degree to which a person believes that using a particular system would be free of effort.                                                                                  | Davis (1989)            |
|                                                                                                          |                       |                        | Perceived Usefulness          | The degree to which a person believes that using a particular system would enhance his or her job performance.                                                                 |                         |
|                                                                                                          |                       |                        | Behavioral Intention to Adopt | Captures an individual's expressed intent to use the PHR technology in a model comprising several types of factors.                                                            |                         |
| Social Cognitive Theory (SCT)                                                                            | Individual Factors    |                        | Computer Anxiety              | An individual's apprehension or fear when is faced with the possibility of using a computer.                                                                                   | (Simonson et al., 1987) |
|                                                                                                          |                       |                        | Social Norm                   | Subjective Norms refer to "a person's perception that most people who are important to him/her think (s)he should or should not perform the behavior in question"              | (Teo, 2009)             |
|                                                                                                          | Environmental Factors | Technological Factors  | Degree of Integration         | The successful putting together of the various components, assemblies, and subsystems of a system and having them work together to perform what the system was intended to do. | (GSAM Handbook, 2003)   |
|                                                                                                          |                       | Organizational Factors | Information Accessibility     | The type and amount of information organized in a way that is accessible to participants.                                                                                      | (Hock et al., 2003)     |
|                                                                                                          |                       |                        | Awareness                     | A condition of being conscious of something.                                                                                                                                   | (Stefania, 2009)        |

Based on the SCT, individual and environmental factors affect the use of patient facing information systems. SCT consider the effect of environment on the individuals' behavior. It also focuses on the peoples' ability in changing the environment in their favor (Gibbons et al., 2009).

### **1.2.1 Individual Factors**

The first component of the framework is “Individual factors” that includes instincts, drives, traits, and other individual motivational forces (Jaars, 2013). According to the framework, individual factors directly or indirectly affect their behavioral intention to adopt an information system. As illustrated in table 2, computer anxiety and Social Norms are the two individual factors examined in this research.

### **1.2.2 Environmental factors**

“Environmental factors” is the second component of our framework and represents situational influences on personal behavior. It is divided into two influential factor groups that affect the users’ intention of utilizing an information system. Technological factors are related to the system properties and development. Degree of integration is the single technological factor under investigation in this study. Organizational factors are those that associate with the system providers and differ from one provider to another. This study examines the effect of information accessibility and awareness on individuals’ intention to use PHR technologies.

## **1.3 Research Question**

This research is an effort to answer the following questions about PHRs user behavior through a quantitative approach.

### **1.3.1 General Research Question**

- What are the interrelationships among technical, organizational and personal factors that affect the adoption and use of Personal Health Records (PHRs) systems?

### **1.3.2 Specific Research Questions**

SRQ1. What are the effects of Computer Anxiety on Individual Intention to use PHRs?

SRQ2. What are the effects of Social Norms on Individual Intention to use PHRs?

SRQ3. What are the effects of Social Norms on the Perceived Ease of Using PHRs?

SRQ4. What are the effects of Information Accessibility on individuals' Computer Anxiety?

SRQ5. What are the effects of PHRs Degree of Integration to the individuals' Perceived Usefulness of PHRs?

SRQ6. What are the effects of Awareness on Perceived Usefulness of PHRs users?

SRQ7. What are the effects of Social Norms on individuals' Awareness of PHRs?

SRQ7. What are the effects of Information Accessibility on individuals' Perceived Usefulness of PHRs?

## **1.4 The Structure of the Thesis**

This research is composed of five chapters. The first chapter includes the introduction, objectives and rationale for this study. The discussion is followed by the second chapter, a literature review on the adoption of PHRs. Third chapter presents the procedures and systematic approach of research design and utilized methodology. Moreover, it discusses the appropriateness of the selected method to the study. The analysis of the survey instrument and evaluation of the empirical model is presented in the chapter four. Finally, chapter five documents main findings of the research and provides research highlights and conclusion.

## **2.0 Literature Review**

### **2.1 Consumer Health Informatics**

Consumer Health Informatics (CHI) is a subdivision of medical informatics which studies health service customers (Eysenbach, 2000). It improves the communication between patients and healthcare providers like physicians, health institutions, labs etc (McDaniel, Schutte, & Keller, 2008; Eyer, 2011) and provides “information structure and processes that empower consumers to manage their health conditions” (McCray, 2005). CHI is positioned at the intersection of several topics including medical informatics, social care, public health, health promotion, health education, marketing and communication science (Flaherty, 2014).

Due to the fast development of the concept, CHI does not have a uniform definition (Arocha et al., 2012; Houston et al., 2001; McDaniel et al., 2008). Gunther Eysenbach defines CHI as “a field that analyzes consumers’ needs for information, studies and implements methods of making information accessible to consumers, and models and integrates consumers’ preferences into medical information systems” (Eysenbach & Jadad, 2001).

In order to develop a consensus definition of CHI, Gibbons et al (2009) examined a survey from the American Medical Informatics Association (AMIA) and gathered a vast range of topics. “Patient decision support” and “patient access to their own health information” has determined the two frequent indicators of CHI.

#### **2.1.1 CHI Evolution and Vision**

During recent years, CHI has been expanded in two major health and IT domains through using software applications in healthcare (Greenes & Shortliffe, 1990). In 1996, modern computers and telecommunication technology had been recruited to offer consumers efficient access to their health information and involve them in making decisions related to their health condition. Later in 1998, health information was accessible to patients through advanced IT and communicative tools. CHI was developed in 2000 through capabilities of analyzing consumers’ information needs and connection of these needs with medical information systems (R. & Gustafson, 1999; Field, 1996; Eysenbach, 2000).

CHI trend and developments not only involved consumers in their healthcare management, but also increased the degree of IT engagement (Field, 1996) While using information and communication technology capabilities are the primary focus of CHI, a major goal is to

increase access to information as well as contribute to making better health decisions (McDaniel et al., 2008). In order to achieve this goal, CHI professionals provide digital access tools, develop skills and support health services (Dolan, Wolter, Nielsen, & Burrington-Brown, 2009).

### **2.1.2 Health information Infrastructure requirements for CHI**

In order to understand the CHI, it is essential to know about its infrastructure. The vision of Health information infrastructure (HII) is to enable providers to have comprehensive, complete and up-to-date information for decision making when needed (Yasnoff et al, 2006). Due to having multiple stakeholders and their conflicting interests, it should be noted that the HII design and implementation requirements should be properly addressed.

Privacy and trust is one of the most important attributes for HII. Lack of privacy is obviously a threat for patient engagement. For this goal, some laws such as HIPAA Privacy Rule in the United States and the *Access to Information Act* and the *Privacy Act* in Canada have been legislated.

The stakeholder cooperation is essential in the availability of the health information at the right time. Most of the stakeholders are reluctant in sharing their records since they are afraid of losing their competitive advantage (Yasnoff et al, 2006). Therefore, some privacy rules such as the HIPAA Privacy in the US make this mandatory to providers to provide patients information upon their request.

The electronic sharing of health information is required that information maintain in electronic form. Since a small proportion (11%) of PHRs benefits and a large proportion of cost (maintaining the system) are attributed to physicians' most of them do not use any type of EHR in their offices (Yasnoff et al, 2006). A justified cost-benefit model is crucial for the adoption of these types of systems in Physician's offices.

Financial Sustainability is the other concern for the HII stability. Few approaches are adopted for this purpose. The most common is to anticipate the cost saving resulted by engage in the CHI. However, it is sometimes challenging to find the exact financial information required for such anticipation as companies doesn't generally share such records. Another good approach is to emphasize new values that could be obtained by the availability of comprehensive health records.

Finally, HII needs to be supported by the right governance in the communities. It reduces the complexities associated with the large projects and increases its success in the local scale.

### 2.1.3 Health Information Consumer Behavior

In order to investigate factors affecting the use of HIT systems, it is necessary to introduce the consumers of health information. According to a large scope mail panel survey (Maibach, Weber, Massett, Hancock, & Price, 2006), consumer behavior toward evaluating, understanding and seeking health information can be categorized into four segments considering two major dimensions of “degree of engagement in health enhancement” and “degree of independence in health decision making”.

Table 2: Health Information Consumers

|                                        |             | Engagement In Health Enhancement |                           |
|----------------------------------------|-------------|----------------------------------|---------------------------|
|                                        |             | Active                           | Passive                   |
| Independence In Health Decision Making | Independent | Independent Actives              | Independent Passives      |
|                                        | Dependant   | Doctor-Dependent Actives         | Doctor-Dependent Passives |

Independent actives are quick in seeking and understanding health information from different sources such as health professionals, the Internet and publications. While they rely on the information obtained from their physicians, they reflect a higher degree of self-efficacy in making their own final decision. In contrast, doctor-dependent actives rely on physicians’ comments and decisions because they usually show a lower level of self-efficacy in understanding health information. For example considering a patient who is searching online for drug interaction of “acarbose” (a drug for reducing blood sugar level to treat type-2 diabetes), if she makes the decision to avoid taking “digoxin” (a drug for treatment of heart failure) prescribed by her doctor to avoid potential negative effects, she would be considered an active independent. However, if she lets the doctor making the decision, she would be considered an active dependent.

Independent and doctor-dependant passives are less assertive towards direct contribution in health information seeking because they consider minimum value for health records. Despite independent passives are less engaged both in seeking health information and relying on their

physicians' information, they make health decisions on their own. Doctor-dependent passives are not interested in obtaining health information and rely on the decisions made by their physicians. In a similar scenario to the previous example, consider a diabetic person who did not search for his medication information online. If the person just decides on using acarbose and digoxin together, he is considered as passive independent. However, if he relies on his physician to make decision for his health condition, he is considered as passive dependent.

Utilization of HIT is significantly affected by the degrees of individuals' self efficacy. People with higher self efficacy reflect higher passion in seeking and understanding health information. Moreover, using HIT requires individuals to be more independent in making health decisions. Patient centered health systems enhance the quality of care primarily through involving patients in their health management activities. Therefore, independent individuals seem to have smoother adoption to the health systems than doctor dependents.

#### **2.1.4 CHI Adoption Challenges**

While the Internet becomes a crucial health information source for public (Fox, 2010), there are some barriers that limit the public search for health related information. These CHI hindrances are both hard factors (non information related factors) and soft factors (information related factors). In the following section, these two groups are explained in detail.

##### **2.1.4.1 Hard Factors**

Disabilities and limitations produced by chronic illnesses prevent patients from seeking health information more than other illnesses (Bylund, Sabee, Imes, & Sanford, 2007). However, there is a higher chance of accessing health information online by chronically ill people who are limited in accessing healthcare services by service providers (e.g. uninsured, greater physical distance/time travel to provider) (Fox & Jones, 2009).

While the effectiveness and efficiency of CHI development reflects obvious return on investment, the high cost of development and maintenance of IT represents the challenge of confronting shrinking public health budget and growing public health service and quality expectations (McDaniel et al., 2008). As Hillestad et al., (2005) states, successful implementation of federal CHI developments with the adoption rate of 90% for direct and ambulatory services can save \$77 billion annually.

Several other demographic factors such as age, gender, education, race/ethnicities, and computer/Internet experiences can directly influence consumer intention to use the Internet as a source for accessing health information (Fox & Jones, 2009). An electronic survey of 264 healthcare customers (Marton, 2011) indicated that perceived source reliability and socio-demographic variables such as race, income, and education significantly influence online health information seeking. For instance, seniors are less likely to obtain their health information through online sources than youth (Fox & Jones, 2009). Since chronically ill people are the primary target for CHI developments, elderly consumers might struggle with different physical limitations ranging from reduced vision and hearing to dexterity reduction (Marquard & Zayas-Cabán, 2009).

#### **2.1.4.2 Soft Factors**

Information related factors affect the individuals' behavioral intention to search for health information. For example, Lack of filtered and organized information records could prevent some consumers to use the Internet for obtaining health information (Swann, Carmona, Ryan, & Raynor, 2009). Therefore, establishing the standards for organization of health records is a key factor in CHI.

The other important factor in assessing the degree of individuals' information seeking is the source of information. Large number of health information sources presenting different levels of quality makes the evaluation and selection process more difficult for the consumers (Field, 1996). Therefore, having limited but reliable health information with a consistent quality reference could simplify the process to obtain health records.

Health information accessibility is considered another crucial factor in assessing individuals' information seeking. Health Literacy of the individuals could directly affect their level of using health records. The different classification of health information consumers has been discussed in the section 2.1.3.

CHI applications have a number of problems in privacy, security and trust (Jahnke, Agah, & Williams, 2011). The health information privacy concerns associated with these applications will be discussed in section 2.5.2.1 in detail.

### **2.1.5 CHI Future Goals**

Improving healthcare quality utilizing the HIT innovations has been strongly pushed as a priority in most of the economically developed countries (Blumenthal & Tavenner, 2010). One major concern in the field of Consumer Health Informatics is to enable consumers to understand health records and make appropriate decisions rather than just providing access to relevant (personalized) and organized health information (Field, 1996). In addition to the quality of information and patient-centric architecture, CHI interventions should address the needs of disabled consumers, physicians and caregivers in terms of design and usability, information exchange and standards of health information technology (Goldberg et al., 2011). As Electronic Health Records (EHRs) remain absent in most care systems, patients and caregivers should take an active role in the medication reconciliation process (Lindeman & Redington, 2010).

## **2.2 Positive Technologies in Patient Healthcare**

Many concepts have been proposed and utilized for better system design and technology use which shifted the care model from “disease centered” to “patient centered” and finally “citizen centered” (Libreri & Graffigna, 2012).

While CHI is a design to align user intention with system understanding (Karray, Alemzadeh, Saleh, & Arab, 2008), Positive Technology (PT) is a design that enhances user empowerment and wellbeing (Ibanez, Dunne, Gaggioli, Ferscha, & Viaud-Delmon, 2011). PT is an emerging field (Serino, Cipresso, Gaggioli, & Riva, 2013) that can be defined as “the scientific approach to using technology to enhance human functioning” (Ibanez et al., 2011) and “improving the quality of our personal experience through its structuring, augmentation and/or replacement” (Graffigna, Barello, Wiederhold, Bosio, & Riva, 2013; Wiederhold & Riva, 2012).

E-health enhances the individuals’ involvement to improve their healthcare (Graffigna, Barello, & Riva, 2013). For example, online therapy for depression and anxiety has been proven to enhance the user experience and individual wellness (Ibanez et al., 2011). Accordingly, PTs can be used for management and tracking of psychological stress (“General Information Packet,” 2014).

PTs including PHRs improve patient-physician relationships through “continuum of care” and enable self engagement and management rather than short ambulatory visits (Ibanez et al., 2011). Continuum of care is defined as a client-oriented system composed of services and integrating mechanisms that guides and tracks clients over time (Evashwick, 2005).

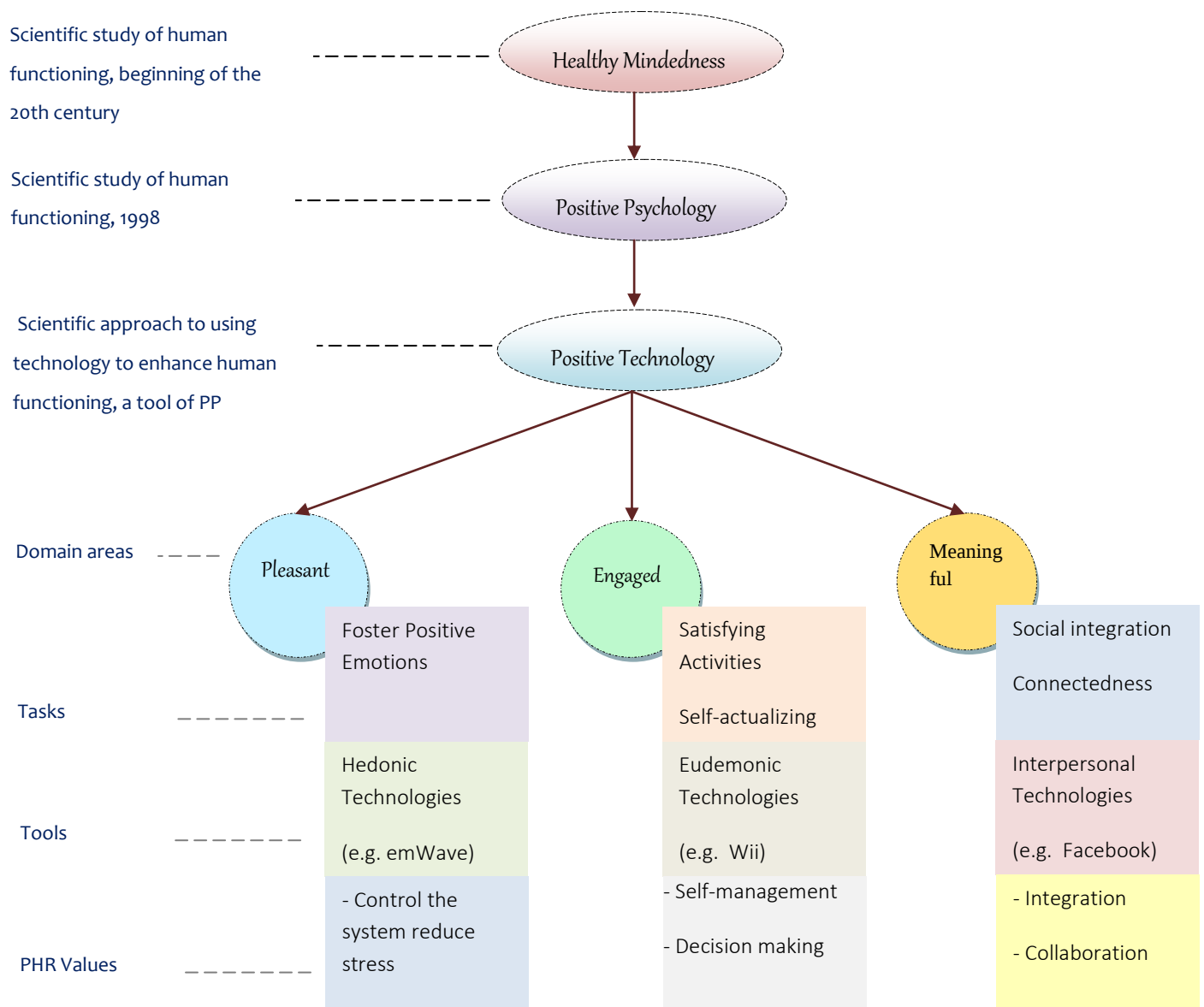


Figure 1: Domain Areas Guiding the Design and Development of Positive Technologies

Figure 1 demonstrates the origins and the main domain areas which positive technology supports. PT is a major tool of Positive Psychology, a concept of Healthy Mindedness. Moreover, the diagram shows the focus and the tools that should be recruited in order to enhance these domain areas. PT includes three main tools: hedonic technologies which aim to enhance positive emotions, eudemonic technologies for user involvement and interpersonal technologies which give users an opportunity for social integration (Graffigna, Barelo, & Riva, 2013). Finally, this figure represents the PHRs features and actions that are positioning the system as a positive technology.

PHRs can be considered to be a positive technology as these tools effectively incorporate the PT's three domain areas. As it shown in the figure, the pleasant life of individuals using PHRs is enhanced when they feel empowered in controlling their health management activities. This empowerment reduces the users' anxiety in their health activities and they experience positive emotions. For example, a diabetic person who uses remote devices for monitoring the level of his blood sugar in a PHRs system can predict his medication time and feels more relaxed (Stachura & Khasanshina, 2007; Vashist, 2012).

Moreover, self management of the health information and decision making of PHRs users increase the level of satisfaction and engagement. For instance, a cancer patient who manages his health information regularly in a PHRs system has continuous interaction with the system and therefore receives more information and updates about his health condition (Surrey & Hospital, 2007). More information empowers him in making his health decision and consequently become more engaged in his health management activities (Brett & McCullough, 2012). If an individual perceives a significant role for himself in assessing his health condition, he will be more satisfied with using the system (BC Ministry of Health, 2011).

Finally, the integration and collaboration of PHRs users with healthcare providers enhance their socialization and meaningful life. For example, PHRs enhance the communication of the patients with physicians, care providers and other patients (Henriksen, Battles, & Keyes, 2008). It gives patients the opportunity to expand their networks and increase the volume of interactions regarding their health conditions. More socialization offered by the system is also another support for considering PHRs as positive technologies.

## 2.3 Patient-Facing Information Systems (PFIS)

### 2.3.1 Consumer Perspective

Considering the health industry trend towards the engagement of consumers with health services, Patient-Facing Information Systems (PFIS) provide different services in information management tasks and also link patients with health professionals (Ahern, Woods, Lightowler, Finley, & Houston, 2011) in order to increase patient understanding and engagement (Wilcox et al., 2010).

Consumer-facing technologies support health consumers with different types of services such as appointment management (Weingart, Rind, & Tofias, 2006; Shah, Kaelber, & Vincent, 2008), consumer-provider communication tools (Houston et al., 2001), self-health monitoring (Weingart et al., 2006), information seeking (Ahern, 2012) presented by PHRs, patients' Web portals, Computerized Tailored Interventions (CTIs), m-health systems, Smartphone health apps, standalone applications and Web 2.0 services (Fox & Jones, 2009).

HIT aims to apply a meaningful use of technology for providing healthcare services in patients' perspective. In order to do so, the functionalities of HIT systems should be patient-centered design and provide value from the patients' point of view Figure 2 illustrates the PFIS functionality framework including value services that make meaningful usage of the system to take place.

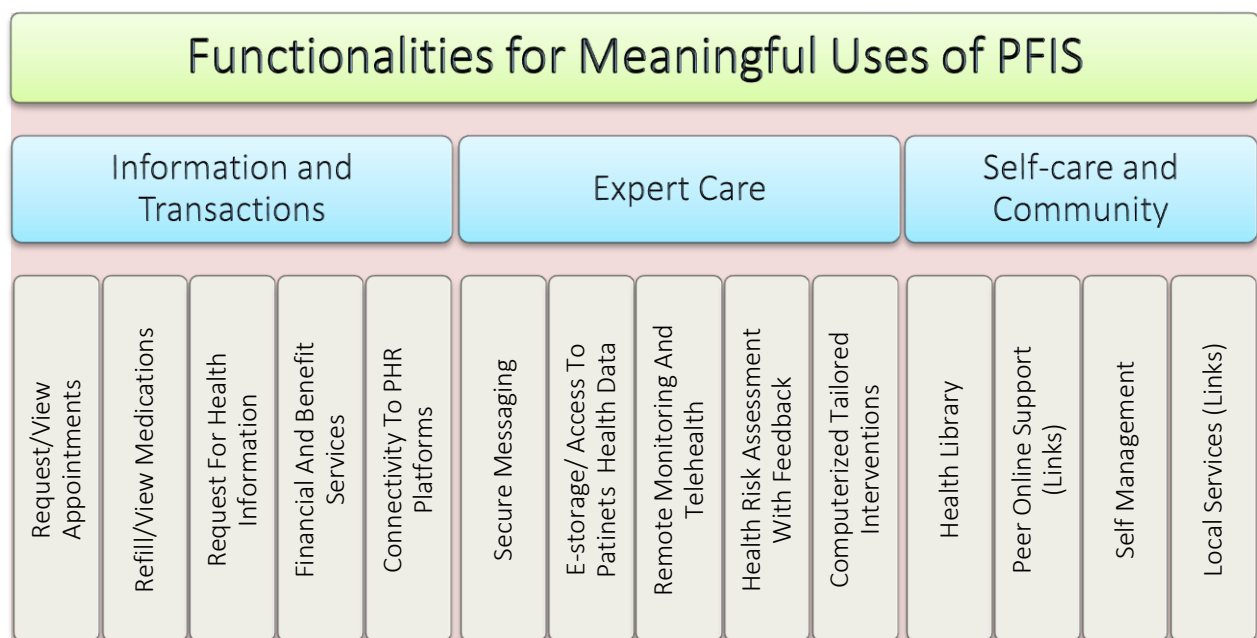


Figure 2: PFIS functionality framework (Adapted from Ahern et al., 2011).

As the diagram shows, functionalities of consumer-facing HIT can be categorized into three groups: “Information and Transactions” (e.g. connectivity with PHRs platforms, requests for health records), “Expert Care” (e.g. messaging, storage, remote monitoring, and risk assessment), and “Self-Care Community” which supports and educates patients through several features such as health library, self management, peer support and local links. Despite the improvements in providing meaningful usage of HIT system, these applications are still immature in their capabilities of enabling health professionals to offer decision support services (Ahern et al., 2011).

Patient-facing health systems could provide an opportunity for users to get involve in their health information management activities. This involvement, especially through collaboration and transferring health information, make patients more prepared during their visits with care providers (Ahern et al., 2011). Therefore, HIT implementation should be more focused on the features that reflect meaningful use of the system in the users’ prospective. For example, an antidepressant drug like SSRI (Selective Serotonin Reuptake Inhibitor) should not be prescribed with the St. John’s Wort, an over-the-counter herbal remedy used to treat depression (Grantham & Brown, 2012). An HIT system like PHRs enables patients to record their herbal habits and empower physicians in making low risk decisions.

Considering required cost and time to communicate with healthcare professionals, HIT benefits economic class individuals and disabled patients by providing a low cost communication platform with effective access to wider range of professionals.

### **2.3.2 Physician Perspective**

The adoption of HIT applications also depends on the acceptance of health professionals. According to (Wilcox et al., 2010), health information sharing with patients is generally accepted by physicians. However, they raised some concerns about the architecture of the system and their changing role.

Physicians were concerned about type and volume of information elements which will be shared in PFIS. For instance, vital signs, medication information, and care team information are identified in favor of physicians to be shared. In contrast, sharing some fields such as lab results and time estimates were considered as inappropriate in physicians’ prospective because of limited patients’ interpretation abilities. Moreover, direct sharing of health information could raise patients’ anxiety and generate a reverse effect on their health condition. This issue could be enhanced when a degree of automatic interpretation is designed in PFIS platforms for

patients. In addition to the above concerns, high volume of shared information with patients could lower their focus on the crucial elements for their decision making.

Health professionals were also concerned about their changing role associated with the using of PFIS. Using these applications should be supported by health professionals in many ways. This not only changes their workload and work style, but also increases their liabilities to supervise the system operation (Wilcox et al., 2010).

## **2.4 Personal Health Records**

### **2.4.1 PHRs definition**

While some researchers believe that Personal health record is a software application (Reti, Feldman, Ross, & Safran, 2010), others also consider paper written health information as PHRs (Walton & Bedford, 2006; Jones, Shipman, Plaut, & Selden, 2010). Stated by National Committee on Vital and Health Statistics (NCVHS), PHRs has an evolving definition. Experts identify PHRs as the presentation of EHR information for patients. Others believe that PHRs can be known as any patient/consumer-managed health record (Cohn, 2006). Lack of uniform definition of PHRs, makes it difficult for professionals and researchers to create policies and collaboration guidelines (Clarke, Meiris, & Nash, 2005).

According to Cohn (2006) there are varieties of attributes which make each definition different than the other such as information scope, information source, system features, information custodian, storage location, technical approval and the party who authorizes information access. Table 3 shows how PHRs definition has evolved during recent decade.

As can be seen in the Table 3, “information scope” and “access authorizer” are universally addressed across the definitions while most of them are missing to specify the “information custodian”. Based on this analysis, the definition by Price (2010) is the most comprehensive which is also utilized in this thesis and we would propose it to be adopted.

Table 3: PHRs Evolving Definitions

| Year                                                                                                                                                                                                                                                                                                                                     | Defined By                         | Information Scope                                                                                                          | Information Source                | System Features                           | Information Custodian     | Storage Location           | Technical Approval     | Access Authorizer        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------|---------------------------|----------------------------|------------------------|--------------------------|
| 2003                                                                                                                                                                                                                                                                                                                                     | Baird                              | Patients' lifelong health information                                                                                      | -                                 | Access and coordinate                     | Patient                   | -                          | Application/ Web       | Provider                 |
| <b>Definition:</b> "A set of computer-based tools that allow people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it".                                                                                                                                         |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2006                                                                                                                                                                                                                                                                                                                                     | Endsley et al.                     | Patient Information                                                                                                        | -                                 | Patient Management                        | -                         | -                          | -                      | Service provider         |
| <b>Definition:</b> "Personal Health Records (PHRs) are designed as tools to engage patients in their health care and to enable them to manage their personal health information".                                                                                                                                                        |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2007                                                                                                                                                                                                                                                                                                                                     | Gearon                             | Patient Health<br>Medication<br>Sensivities<br>Examinations<br>Educational Material<br>Web links<br>Exercise and diet logs | Health centers                    | Collecting, tracking and sharing          | -                         | Web server                 | -                      | Service provider         |
| <b>Definition:</b> "A PHRs system is a tool for collecting, tracking and sharing important, up-to-date information about an individual's health, current medications, allergies or sensitivities, summaries from recent examinations, current educational materials or web links relating to a person's health, diet and exercise logs". |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2008                                                                                                                                                                                                                                                                                                                                     | David Wiljer et al.                | Health information<br>Other authorized information from other sources                                                      | Internal and external sources     | Access, manage and share                  | -                         | Server                     | Electronic application | Service provider/Patient |
| <b>Definition:</b> "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".                                                                                                     |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2009                                                                                                                                                                                                                                                                                                                                     | Joel Rodrigues                     | Patient Information                                                                                                        | Copies of parts of health records | Measured and/or noticed by the individual | Patient, System Admin     | -                          | -                      | Patient, System Admin    |
| <b>Definition:</b> "A longitudinal collection of personal health information of single individual containing copies of parts of health records, health related data measured and/or noticed by the individual and administrative data."                                                                                                  |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2010                                                                                                                                                                                                                                                                                                                                     | Bates DW, Bitton A.                | Patient information                                                                                                        | -                                 | Information Access                        | Not mentioned             | Web Server                 | Web-based portals      | Service provider         |
| <b>Definition:</b> "Personal Health Records (PHRs), typically accessible through secure Web-based portals, represent a practical way for patients to access their health information anytime and anywhere".                                                                                                                              |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2010                                                                                                                                                                                                                                                                                                                                     | Jones et al.                       | Patient information                                                                                                        | -                                 | Access, manage, and share                 | -                         | Server                     | Application            | Patient                  |
| <b>Definition:</b> "A private [and] secure application through which an individual may access, manage, and share his or her health information.                                                                                                                                                                                          |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2010                                                                                                                                                                                                                                                                                                                                     | Audrey P. Price                    | A part of EHR information                                                                                                  | EHR Healthcare professionals      | -                                         | health care professionals | Clinic or hospital servers | Application            | Physician                |
| <b>Definition:</b> "A Personal Health Record (PHR) is the final, yet very separate, component of an EHR".                                                                                                                                                                                                                                |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |
| 2010                                                                                                                                                                                                                                                                                                                                     | Hoerbst, Kohl, Knaup, & Ammenwerth | A part of EHR information                                                                                                  | EHR Healthcare professionals      | Manage                                    | health care professionals | Clinic or hospital servers | Application            | Physician                |
| <b>Definition:</b> "An EHR that allows the patient to actively manage his/her data is also called a Personal Health Record (PHR)".                                                                                                                                                                                                       |                                    |                                                                                                                            |                                   |                                           |                           |                            |                        |                          |

### 2.4.2 PHRs History

PHRs is a relatively old concept. During many years, patients utilize paper-based information transferred among healthcare professionals to ensure that sufficient amount of information delivers an appropriate level of quality and support for health management and decision making (Clarke et al., 2005). The idea of personal health record started at 1991 in a Medicine Institutes report titled as: “The Computer-Based Patient Record: An Essential Technology for Healthcare” (Dick & Steen, 1991). The original edition has been prepared by Richard, Elaine & Don in 1997.

In 2005, the Office of the National Coordinator for Health Information Technology (ONCHIT) defined “the use of health information technology that produces a tangible and specific value to the health care consumer and that can be realized within a 2-3 year period” as its breakthrough described in the following three categories.

- I. Personal health record which is a person-centered system that track and support lifelong health without being limited to a single provider.
- II. Electronic medical record is a digital platform to manage medical information gathered in hospital or physician.
- III. Electronic health record is a digital collection of patients’ health information gathered and managed by healthcare providers. Some believe that EHR is the combination of EMR and PHR. However, EHR systems are used by healthcare professionals not patients (Clarke et al., 2005).

### **2.4.3 PHRs Goals, Types, Architectures**

#### **2.4.3.1 PHR Goals**

The major goals of the personal health system are to integrate, enable portability and stop duplication of healthcare information (Goldman, 2008). Generally, PHRs goal is to increase patients' lifelong (Ofstedahl & Marshall, 2010) access and ownership over their health information (Wynia & Dunn, 2010). The system also aims to standardize, stabilize and formalize the transferring patient's records to a new physician (Goldman, 2008).

#### **2.4.3.2 PHRs Types**

Similar to its definition, PHRs has been classified in different ways. These classifications are different in terms of system provider, system channel and the types of user. In 2002, Waegemann purposed groups of PHRs: Off-line, Web-based, Purpose-based, Provider-based and Partial (Waegemann, 2002). (Maloney & Wright, 2010) divided personal health systems to Off-line PHRs, Smart cards, PHRs kiosks, Web-based and USB-based PHRs. In 2011, Krohn classified PHRs into Stand-alone, Health plan patient portals, Electronic medical record (EMR) patient portals and Consumercentric (Krohn, 2007).

#### **2.4.3.3 PHRs Architecture**

The health data repository, management and disposal of personal health records can be determined by the architecture that it follows (Koufi, 2010). PHRs architecture can be divided into three different models (Tang, Ash, & Bates, 2006) based on the delivery system in which consumer and provider communicate (Barlow, Crawford, & Lansky, 2008).

- 1- Standalone PHRs in which consumers create and maintain their health information.
- 2- Tethered PHRs in which consumers are authorized accessing to provider's stored information. This type can be connected to the provider's EMR and presents a subset of its stored data (Jahnke et al., 2011). (e.g. Infowell represents as the subset for University Health Network in Ontario)
- 3- Interconnected PHRs in which consumers are capable of accessing and sharing records from numerous sources. (e.g. organizations and centers)

## Data Elements to Complete the Patient Profile

A complete and organized set of data elements which could possibly captured by personal health record systems is presented in Table 4. Moreover, the mobile app supported fields have is identified in a separate column in the table. The assortment of personal health system data element depends on the architecture that the system follows. For example, most of tethered PHRs systems have limited data store capabilities to clearly separate patient and caregiver data elements (Jahnke et al., 2011).

Table 4: Data Elements to Complete the Patient Profile

| Data Group                    | Data Element                                                         | Possible Data Source |           |                     |                      |         |           |        | Mobile Apps | Support            |                       |                  |                   |                     |                    |              |
|-------------------------------|----------------------------------------------------------------------|----------------------|-----------|---------------------|----------------------|---------|-----------|--------|-------------|--------------------|-----------------------|------------------|-------------------|---------------------|--------------------|--------------|
|                               |                                                                      | Patient              | Caregiver | Healthcare Provider | EHR/Clinical Systems | Devices | Insurance | Claims |             | Karla et al., 2012 | Kharrazi et al., 2012 | Wen et al., 2011 | Anna et al., 2012 | Jahnke et al., 2011 | Sarah et al., 2013 | Calvin, 2007 |
| Medical Information           | X-rays                                                               |                      |           | ✓                   | ✓                    |         |           |        |             | ✓                  |                       |                  |                   |                     |                    | ✓            |
|                               | Test and exam results                                                |                      |           | ✓                   | ✓                    |         |           |        | ✓           | ✓                  | ✓                     | ✓                | ✓                 | ✓                   | ✓                  | ✓            |
|                               | Physician notes                                                      |                      |           | ✓                   | ✓                    |         |           |        |             | ✓                  |                       |                  |                   |                     |                    |              |
| Insurer Data                  | All instances of care regardless of location                         |                      | ✓         | ✓                   | ✓                    | ✓       |           |        |             | ✓                  |                       |                  |                   |                     |                    |              |
|                               | All claims regardless of health insurers                             | ✓                    |           |                     | ✓                    |         | ✓         | ✓      | ✓           | ✓                  | ✓                     |                  |                   |                     |                    | ✓            |
|                               | Financial situation                                                  |                      |           | ✓                   | ✓                    |         |           |        |             | ✓                  | ✓                     |                  |                   |                     |                    | ✓            |
|                               | Health insurance information                                         | ✓                    |           | ✓                   | ✓                    |         | ✓         |        |             |                    |                       |                  |                   | ✓                   |                    | ✓            |
|                               | Providers                                                            | ✓                    | ✓         | ✓                   | ✓                    |         | ✓         | ✓      |             |                    | ✓                     |                  |                   |                     |                    | ✓            |
|                               | Face sheet                                                           | ✓                    |           | ✓                   | ✓                    |         | ✓         |        |             |                    |                       | ✓                |                   |                     |                    | ✓            |
| Medications                   | Drugs, dosages, adherence, medications regardless of pharmacy filled | ✓                    | ✓         | ✓                   | ✓                    |         |           |        |             |                    | ✓                     |                  |                   |                     | ✓                  | ✓            |
|                               | Medical encounter                                                    |                      | ✓         | ✓                   | ✓                    |         |           |        |             |                    |                       | ✓                |                   |                     | ✓                  |              |
|                               | Prescription                                                         |                      |           | ✓                   | ✓                    |         |           |        |             |                    |                       | ✓                |                   |                     |                    | ✓            |
| Clinical Trials               | Connection to clinical research trials                               | ✓                    |           | ✓                   | ✓                    |         |           |        |             | ✓                  |                       |                  |                   |                     | ✓                  | ✓            |
|                               | Clinical trials & treatment changes                                  | ✓                    |           | ✓                   | ✓                    |         |           |        |             | ✓                  |                       |                  |                   |                     | ✓                  |              |
| Lifestyle/ Behavior           | Patient self reported data                                           | ✓                    |           |                     | ✓                    |         |           |        |             | ✓                  |                       |                  | ✓                 |                     |                    |              |
|                               | Social media posts                                                   | ✓                    |           |                     | ✓                    |         |           |        |             | ✓                  |                       |                  |                   |                     |                    |              |
|                               | Mobile monitors/Telehealth                                           | ✓                    |           |                     | ✓                    | ✓       |           |        |             | ✓                  |                       |                  |                   |                     |                    |              |
|                               | Socioeconomic data                                                   | ✓                    |           |                     | ✓                    |         |           |        |             | ✓                  |                       |                  |                   |                     |                    |              |
| Personal Identifier Elements  | Personal identification information                                  | ✓                    |           |                     | ✓                    |         | ✓         |        |             |                    |                       |                  | ✓                 | ✓                   |                    | ✓            |
|                               | Emergency contact                                                    | ✓                    |           |                     | ✓                    |         | ✓         | ✓      |             |                    | ✓                     |                  |                   | ✓                   |                    | ✓            |
|                               | Family history                                                       | ✓                    |           |                     | ✓                    |         |           |        |             |                    |                       |                  | ✓                 |                     |                    | ✓            |
| Sensitivities / Immunizations | Allergies                                                            | ✓                    |           | ✓                   | ✓                    |         |           |        | ✓           |                    | ✓                     |                  | ✓                 | ✓                   | ✓                  | ✓            |
|                               | Immunizations and their dates                                        | ✓                    |           | ✓                   | ✓                    |         |           |        | ✓           |                    | ✓                     |                  | ✓                 | ✓                   | ✓                  | ✓            |

| Data Group                    | Data Element                                                                                                              | Possible Data Source |           |                     |                      |         |                  |   | Mobile Apps | Support                |                       |                   |                    |                     |                      |              |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------|-----------|---------------------|----------------------|---------|------------------|---|-------------|------------------------|-----------------------|-------------------|--------------------|---------------------|----------------------|--------------|
|                               |                                                                                                                           | Patient              | Caregiver | Healthcare Provider | EHR/Clinical Systems | Devices | Insurance Claims |   |             | Patterson et al., 2012 | Kharrazi et al., 2012 | Jian et al., 2011 | Smith et al., 2012 | Jahnke et al., 2011 | Collins et al., 2011 | Fisher, 2007 |
| Emergency Records             | Emergency note                                                                                                            | ✓                    | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       | ✓                 |                    |                     |                      |              |
|                               | Emergency order                                                                                                           | ✓                    | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       | ✓                 |                    |                     |                      |              |
|                               | Emergency triage note                                                                                                     | ✓                    | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       | ✓                 |                    |                     |                      |              |
|                               | Organ donor authorization                                                                                                 | ✓                    |           |                     | ✓                    |         |                  |   |             |                        |                       |                   |                    | ✓                   |                      |              |
| Self Management               | Self assessments                                                                                                          | ✓                    |           |                     |                      |         |                  |   |             |                        |                       |                   | ✓                  |                     |                      |              |
|                               | Self management strategies                                                                                                | ✓                    |           |                     |                      |         |                  |   |             |                        |                       |                   | ✓                  |                     |                      |              |
| Admission Records             | Admission note                                                                                                            |                      | ✓         |                     | ✓                    |         |                  |   |             |                        |                       | ✓                 | ✓                  |                     |                      |              |
|                               | Progress note                                                                                                             |                      | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       | ✓                 | ✓                  |                     |                      | ✓            |
|                               | Discharge summary                                                                                                         |                      | ✓         |                     | ✓                    |         |                  |   |             |                        |                       | ✓                 |                    |                     | ✓                    |              |
|                               | Permission forms for release of Information, operations and procedures                                                    | ✓                    | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       |                   |                    | ✓                   | ✓                    |              |
|                               | Referral sheet                                                                                                            |                      | ✓         |                     | ✓                    |         |                  |   |             |                        |                       | ✓                 |                    |                     |                      |              |
| Problems/ Conditions          | Problems/ diagnostics                                                                                                     | ✓                    |           | ✓                   | ✓                    |         |                  | ✓ |             | ✓                      |                       |                   | ✓                  |                     | ✓                    | ✓            |
|                               | Hospitalizations                                                                                                          | ✓                    |           |                     | ✓                    |         | ✓                |   |             |                        |                       |                   | ✓                  |                     |                      | ✓            |
|                               | A list and dates of significant illnesses and surgeries                                                                   | ✓                    |           | ✓                   | ✓                    |         |                  |   |             |                        |                       |                   | ✓                  | ✓                   |                      | ✓            |
|                               | Procedures                                                                                                                | ✓                    |           | ✓                   | ✓                    |         | ✓                | ✓ |             | ✓                      |                       |                   | ✓                  |                     |                      | ✓            |
|                               | Home monitor data                                                                                                         | ✓                    | ✓         |                     | ✓                    | ✓       |                  |   |             |                        |                       |                   | ✓                  |                     |                      |              |
|                               | Any other miscellaneous Information about patient health Such as exercise regimen, herbal Medications, and any counseling | ✓                    | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       |                   |                    | ✓                   |                      |              |
| Health Background             | Family history                                                                                                            | ✓                    |           |                     | ✓                    |         |                  | ✓ |             | ✓                      |                       |                   |                    |                     | ✓                    |              |
|                               | Social history                                                                                                            | ✓                    |           |                     | ✓                    |         |                  |   |             |                        |                       |                   | ✓                  |                     | ✓                    |              |
|                               | Hereditary conditions in family                                                                                           | ✓                    |           |                     | ✓                    |         |                  |   |             |                        |                       |                   | ✓                  | ✓                   | ✓                    |              |
| Communication With Caregivers | Important appointments, events, dates                                                                                     | ✓                    |           |                     | ✓                    |         | ✓                |   |             |                        |                       |                   | ✓                  | ✓                   |                      |              |
|                               | Correspondence with providers                                                                                             | ✓                    | ✓         | ✓                   | ✓                    |         |                  |   |             |                        |                       |                   |                    | ✓                   |                      |              |
|                               | Numbers of physician, dentist, specialists                                                                                | ✓                    |           |                     | ✓                    |         |                  |   |             |                        |                       |                   |                    | ✓                   |                      |              |
|                               | Preventive health recommendations                                                                                         |                      |           | ✓                   | ✓                    |         |                  |   |             |                        |                       |                   | ✓                  |                     |                      |              |
|                               | Opinions of specialists                                                                                                   |                      |           | ✓                   | ✓                    |         |                  |   |             |                        |                       |                   |                    | ✓                   |                      |              |

#### **2.4.4 Types of PHRs Services**

The type of services and user information access authorization provided by PHRs can be different depending on who the service owner is and what specifications have been designed to meet the needs of the owners. Some studies (Endsley, Kibbe, Linares, & Colorafi, 2006; Fisher, 2007), categorized these services into provider-owned, patient-owned and portable interoperable PHRs services. Another type of personal services is payers-owned PHRs which might operate and maintain by either insurance companies or governmental bodies. Patient- and provider-owned PHRs offer free services while using government and payer-owned PHRs are fee-based. Delivery of PHRs services could be offered through Cloud PHRs, hosted PHRs, PC-stored PHRs and mobile PHRs (Jahnke et al., 2011).

##### ***2.4.4.1 Patient-Managed/Independent-Sponsored PHRs (Free Apps)***

For those health information access authorizations using the patient-managed service model, physical or electronic forms should be completed by patients in order to enable data gathering and claim processing. Collected data might be then received by patient or alternatively transferred directly to the vendors (Kappeler, 2013).

##### **Patient portals supported by providers**

Although comparing with health institutions and hospitals this type of PHRs systems serve consumers with a wider range of services (Deshazo, 2010), most of the provider-supported PHRs that maintain their own data storage can only serve consumers with presentation of the read-only health information including lab reports and illness records (Sood et al., 2007). Often in provider-owned PHRs, the electronic version of clinical report summaries is organized and presented to consumers (Fisher, 2007).

In this model, patients' authorization is obtained during the registration process. Consumers are required to agree the privacy policies and terms of use in order to utilize the system. If users register at the providers' front counter (face to face registration), physical similar form should be signed and agreed alternatively (Kappeler, 2013).

### **PHRs Owned/Used by Patients (Free)**

Some personal health systems enable user-entered data to be maintained and organized by consumers (Sood et al., 2007). Therefore, health records contain patients' interpretations and information sharing with professionals could be challenging. Patient-owned PHRs can be an application on personal computers or a Websites accessible through the Internet. The major weakness of this model is the amount of data entry required time and effort by individuals. Hence, for this type of PHRs systems, the effort expectancy could be a major acceptance barrier. Using smartphones, smartcards and PDAs (Fisher, 2007) in this model, a digital version of health information could be transferred or exchanged anonymously (Tang & Lansky, 2005).

Various types of PHRs services have different capabilities and limitations when some specific services are required. For example, when shifting from one health professional to another, a copy of medication history (normally from provider-owned EMR systems) is required (Wang, Lau, Masten, & Kim, 2003). Obtaining referral forms could be challenging for providers or government owned PHRs models. In patient-owned systems however, user can access a real-time lifelong medical records from multiple providers (Wang, Lau, Masten, & Kim, 2003) without going through bureaucracy.

#### ***2.4.4.2 Corporation Health Plans (Fee-Based Apps)***

Using corporation supported PHRs users should pay for health services through periodical subscription programs. In payer and government supported PHRs, a broad exchange and authorization of health information should be conducted with vendors and insurance companies. Developing various stages, users should authorize all involved parties prior to login and utilizing the system. In another format (trail for example), patient can authorize or unauthorized the service owner (Kappeler, 2013).

### **PHRs Provided by Payers (Insurance)**

Personal health systems provided by payers have been designed to serve different objectives. For instance, insurance supported PHRs could collect health records in an appropriate format which make the claim processing more effective. When submitting a claim, users will be able to access the data in their profile. This model might be either provided by insurance companies or the individuals' employers (Vecchione, 2012).

### PHRs Provided by Payers (Government, etc)

In some countries such as the United States and Canada, governments make the personal health record as a global citizen healthcare planning priority. In some European countries, particularly France and United Kingdom, personal health records have been developed and supported in multinational scope (Baird, 2003) as a part of health information technology development plan.

Currently, PHRs cost effectiveness is hindered by lack of appropriate business case (Black et al., 2011). In general, a PHRs designed for revenue might fall into one of the categories demonstrated in Table 5 (Jahnke et al., 2011);

Table 5: PHRs Revenue Model

| Revenue models | Founding source                                                                                                                         | Founding technique                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Provider       | Healthcare providers (hospitals, health authorities, insurance carriers, or employers)                                                  | PHRs service fees are often hidden in clinical bills.                                                                                |
| Consumer       | Funded, PHRs, offer subscription or license services paid for by patients/consumers.                                                    | Consumers are required to pay one time-fee or ongoing fees.                                                                          |
| Advertisement  | Funded, PHRs, are financed through third party companies who have an interested in marketing products and services to health consumers. | Health related companies such as pharmaceutical, sport and etc could target PHRs consumers for marketing their products or services. |
| Research       | Funded, PHRs & receive their funding from organizations conducting medical research.                                                    | Public or private institutions or labs might found local, national or international health projects.                                 |

One of the challenges in PHRs business model is lack of incentives for physicians. A good business model should sufficiently compensate perceived extra workload of using personal health system physicians to become accepted. For instance, Schneider (2010) outlined increasing Medicare compensation for physicians who use a certified EHR by 2012.

PHRs consumers are interested toward receiving more features and also have willingness to pay more. In a study over health consumers (Copeland & Keckley, 2008), 60% of the respondents were interested to receive more features (e.g. online appointment scheduling, access to records and test results) and 25% of the respondents were ready to pay for extra services.

#### **2.4.5 Mobile PHRs and PHR Portals**

Web applications that offer access to health information, provide advice or support the peer communication are growing in numbers (Demiris, 2012). Some believe that due to lack of accuracy in patient generated input data, web-based PHRs should be apart from organizational EHRs. For the security purpose, PHRs are using protocols like HTTPS and 128 bit encryption of stored information which makes it difficult for intruder's access to health information (Win, Susilo, & Mu, 2006).

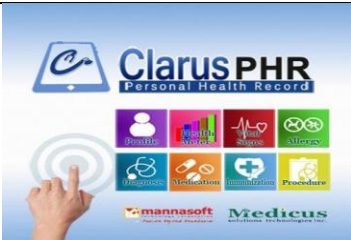
##### **Mobile PHRs**

Widespread adoption of mobile technology pushes health information management to web-based platforms (Caligtan & Dykes, 2011). Mobile PHRs include devices like USB keys, smart cards and smartphone apps which offer portable capabilities to users. USB keys are also capable of connecting to health kiosks and enable patients to manage their records in an ATM style interface (Win, Susilo, & Mu, 2006). Using these devices has been illustrated in consumer self health-management (Schattner et al., 2004).

For instance, LIFECompass PHRs offers USB key to patients (Blair, 2006), and HealthTeam Kennedy, (2013) provide smartcards to connect members with insurers, caregivers and physicians. Mobile applications such as actigraphy or vital sign devices are pervasively integrated into our lives, and sensor technologies become part of our residential infrastructure (Demiris, 2012). Table 6 Illustrated mobile and portal PHRs providers in the North American market, their service platforms, features, business model and finally their highlighted properties.

Table 6: PHRs Mobile and Portals

| Company                                                                                                                                                                                    | Web Portal | App     |     | Functions and features                                                                                                                                                                                                                                 | Revenue model |          |               |          | Properties                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------|---------------|----------|-----------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                            |            | Android | iOS |                                                                                                                                                                                                                                                        | Provider      | Consumer | Advertisement | Research |                                                                                                           |
| <br><a href="http://www.telushealth.com">http://www.telushealth.com</a>                                   | ✓          | ✓       | ✓   | Electronic access to health data held by your health professional<br><br>Access to easy tools for managing your health data                                                                                                                            | ✓             |          |               |          | Free<br>Powered by Microsoft<br>Can be connect to health devices                                          |
| <br><a href="http://www.snowbirds.org/home">http://www.snowbirds.org/home</a>                             | ✓          |         |     | Create, edit and save two (2) individual Health Records, while registered Users can use the Service on a single use basis, only.                                                                                                                       |               | ✓        |               |          | Powered by Norton and VeriSign<br><br>National not-for-profit advocacy organization                       |
| <br><a href="http://myoscar.org/">http://myoscar.org/</a>                                                |            | ✓       | ✓   | Health Information management<br>Secure Messaging<br>Online appointment booking<br>Health Management Tools                                                                                                                                             |               |          |               | ✓        | An Open Source PHRs System<br><br>McMaster \$5.8 million PHRs project                                     |
| <br><a href="https://www.mydoctor.ca/patient/welcome.do">https://www.mydoctor.ca/patient/welcome.do</a> | ✓          |         |     | Keep track of health information<br><br>Share information<br><br>Access information<br><br>Rely on a trusted partner                                                                                                                                   |               | ✓        |               |          | Patients must be invited by doctors<br><br>Patient License fee is currently \$19.95 per year (plus taxes) |
| <br><a href="https://www.mihealth.com/">https://www.mihealth.com/</a>                                   | ✓          |         | ✓   | Access medical information, including diagnoses, family history, immunizations, medication and allergies<br>patient can then share this information with other primary care doctors, specialists or family members by e-mailing, printing or faxing it |               | ✓        |               |          | Membership \$9.99<br>mihealthView™                                                                        |

| Company                                                                                                                                                  | Web Portal | App     |     | Functions and features                                                                                                                                                                             | Revenue model |          |               |          | Others                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------|---------------|----------|---------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                          |            | Android | iOS |                                                                                                                                                                                                    | Provider      | Consumer | Advertisement | Research |                                                                                                               |
| <br><a href="http://www.hbf.com.au">http://www.hbf.com.au</a>           |            | ✓       | ✓   | Track and monitor your health, fitness and wellbeing.<br>Schedule reminders for appointments.<br>Designed by iMedicalApps Team                                                                     |               | ✓        | ✓             |          | Free limited function<br>\$0.99 track radiology results, lab results, etc.<br>\$3.99 Family Ver. all features |
| <br><a href="http://www.myhealthme.com/">http://www.myhealthme.com/</a> | ✓          | ✓       |     | Healthcare Information Management<br>Personalized Food Plan<br>Personalized Exercise Plan<br>Real-Time Advice, Encouragement and Support<br>Weight Loss Plan reporting functions                   |               | ✓        |               |          | HealtheMe™ Open-Source PHRs System<br><br>Monthly Plan \$9.99<br><br>Certified by TRUSTe                      |
| <br><a href="http://phr.ph/">http://phr.ph/</a>                        |            | ✓       | ✓   | track vital signs (Blood Pressure, Temperature, etc), Medications history, Allergies History, Diagnostics History, Immunization History and Procedures History                                     |               |          | ✓             |          | Free App                                                                                                      |
| <br><a href="http://mymedicalapp.com/">http://mymedicalapp.com/</a>   | ✓          |         |     | provide medications summary information retrieval<br>BMI<br>Track Medications, Allergies, Conditions, Immunizations, Procedures, Appointments<br>Graph for blood pressure, blood sugar level, etc. | ✓             |          |               |          | Free App<br>Cloud storage<br>redundant servers and continuous backups.<br>encrypted (SSL) connections         |
| <br><a href="http://myphr.ca/">http://myphr.ca/</a>                   | ✓          | ✓       | ✓   | Current medical conditions<br>Medical Surgical Allergies History<br>Emergency contact information<br>Sensitivity<br>Insurance<br>Immunizations                                                     |               |          | ✓             |          | Free Membership<br><br>Certified Hackerproof Website                                                          |

#### 2.4.6 PHRs Stakeholders and Value Proposition

Despite large number of personal health system inevitable benefits for each group of stakeholders, it is identified that not all the benefits for consumers and providers are recognized (Tang, Ash, & Bates, 2006; Kevin J. Leonard, 2008). PHRs benefits to its stakeholders are significantly hindered with challenges such as ambiguous definition, lack of standard, unreliable patient entered data, security and many more (Kharrazi, Chisholm, VanNasdale, & Thompson, 2012).

Table 7 shows an organized set of benefits which a personal health record system might provide to its stakeholders. These benefits mainly contribute into patient awareness and empowerment, user efficiency, overall cost effectiveness, improved communication, provider risk management and public benefits. As it can be seen in the table, the benefits related to “awareness and empowerments” and “public benefits and adoption” is more delivered to the patients and government. However, the “communication with the providers” and “providers’ risk management” benefits all the presented stakeholder groups. Also, the “cost effectiveness” of the PHRs for physicians is not supported as they are not affected by the patients’ costs of care.

Table 7: PHRs Stakeholders and Value Propositions

| Area                                                                     | Benefits                                                                               | Literature Support                                                                                                                                                   | Stakeholder groups   |                        |                          |           |             |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------|--------------------------|-----------|-------------|
|                                                                          |                                                                                        |                                                                                                                                                                      | Patient<br>/Consumer | Physicians<br>/Doctors | Clinicians<br>/Hospitals | Providers | /government |
| Patient Awareness, Understanding, Empowering and controlling, Efficiency | Increased Health Information Awareness                                                 | (Smith et al., 2012)                                                                                                                                                 | ✓                    |                        |                          |           | ✓           |
|                                                                          | Save patients' time                                                                    |                                                                                                                                                                      | ✓                    |                        |                          |           |             |
|                                                                          | Medical information validity and accuracy                                              | (Wuerdeman et al., 2005)                                                                                                                                             | ✓                    |                        |                          |           |             |
|                                                                          | Increase health understanding                                                          | (Kahn, Aulakh, & Bosworth, 2009)                                                                                                                                     | ✓                    |                        |                          |           | ✓           |
|                                                                          | Transform patients into informed and empowered healthcare consumers                    |                                                                                                                                                                      | ✓                    |                        |                          |           | ✓           |
|                                                                          | Increase patient understanding                                                         | (Ross, Moore, Earnest, Wittevrongel, & Lin, 2004)                                                                                                                    | ✓                    |                        |                          |           | ✓           |
|                                                                          | Clarify patient instruction                                                            |                                                                                                                                                                      | ✓                    |                        |                          |           |             |
|                                                                          | Promotes consumer education                                                            | (Adams, Greiner, & Corrigan, 2004)                                                                                                                                   | ✓                    |                        |                          |           | ✓           |
|                                                                          | Enhanced consumer empowerment                                                          | (McDaniel et al., 2008)                                                                                                                                              | ✓                    |                        |                          |           |             |
|                                                                          | Greater personal control over health outcomes (e.g. chronic disease management)        |                                                                                                                                                                      | ✓                    |                        |                          |           |             |
|                                                                          | Providing convenience to individuals when undertaking health-related activities        | (Brennan, Downs, & Casper, 2010; Endsley, Kibbe, Linares, & Colorafi, 2006; Crisp, 2012; Ralston, Revere, Robins, & Goldberg, 2004; (Weingart, Rind, & Tofias, 2006) | ✓                    |                        |                          |           |             |
|                                                                          | Identify barriers and provide cues for action and facilitate self-efficacy             | (Demiris, 2012)                                                                                                                                                      | ✓                    |                        |                          |           |             |
| Cost effectiveness                                                       | Reduces the cost of chronic disease management                                         | Tang & Lansky, 2005                                                                                                                                                  | ✓                    |                        |                          | ✓         |             |
|                                                                          | Reduce cost of duplication tests                                                       | (Galanis, 2014)                                                                                                                                                      | ✓                    |                        |                          |           | ✓           |
|                                                                          | Minimizes duplication of procedures                                                    | (Adams, Greiner, & Corrigan, 2004)                                                                                                                                   | ✓                    |                        |                          | ✓         |             |
| Communication with providers                                             | More patients- providers conversation                                                  | (Smith et al., 2012)                                                                                                                                                 | ✓                    | ✓                      |                          |           | ✓           |
|                                                                          | Improve communication of health information to various care providers                  | (McDaniel et al., 2008)                                                                                                                                              | ✓                    |                        |                          |           |             |
|                                                                          | Improved communication with providers                                                  | (Adams, Greiner, & Corrigan, 2004)                                                                                                                                   | ✓                    | ✓                      |                          |           | ✓           |
|                                                                          | Ability to share patient information in a timely manner impacts clinical decisions     |                                                                                                                                                                      |                      | ✓                      | ✓                        |           |             |
|                                                                          | Involve stakeholders to determine the action that needs to be taken                    | (Demiris, 2012)                                                                                                                                                      |                      | ✓                      | ✓                        |           |             |
| Provider efficiency and effectiveness risk management                    | Increasing the quality of care and safety                                              | Brennan, Downs, & Casper, 2010; Endsley, Kibbe, Linares, & Colorafi, 2006; Crisp, 2012; Ralston, Revere, Robins, & Goldberg, 2004; (Weingart, Rind, & Tofias, 2006)  | ✓                    | ✓                      | ✓                        |           | ✓           |
|                                                                          | Save their providers' time                                                             | (Smith et al., 2012)                                                                                                                                                 |                      | ✓                      | ✓                        |           | ✓           |
|                                                                          | Handling emergency situations                                                          | (Hart, 2009)                                                                                                                                                         | ✓                    | ✓                      | ✓                        |           |             |
|                                                                          | Durability of patient data (offsite storage)                                           | (Tang et al., 2006)                                                                                                                                                  |                      |                        |                          |           |             |
|                                                                          | Provide information to demonstrate areas of susceptibility (e.g., low activity levels) | (Demiris, 2012)                                                                                                                                                      |                      | ✓                      | ✓                        |           |             |
|                                                                          | Specify consequences of the health risks (outlining the perceived severity)            |                                                                                                                                                                      |                      | ✓                      | ✓                        |           |             |
| Public benefits and adoption                                             | Jurisdictions affecting norms and values                                               | (Allsop & Ruhi, 2012)                                                                                                                                                |                      |                        |                          |           | ✓           |
|                                                                          | Improves population-based care                                                         | (Adams, Greiner, & Corrigan, 2004)                                                                                                                                   | ✓                    |                        |                          |           | ✓           |
|                                                                          | Facilitation of public health research                                                 | (Tang et al., 2006)                                                                                                                                                  |                      |                        |                          |           | ✓           |
|                                                                          | Widespread public acceptance of information                                            |                                                                                                                                                                      |                      |                        |                          |           | ✓           |
|                                                                          | Introduce tailored, data-driven scalable solutions for personal health management      | (Demiris, 2012)                                                                                                                                                      | ✓                    |                        |                          |           |             |

#### **2.4.7 PHR Case Study: Blue Button Initiative**

Recent successful initiatives such as Facebook and Twitter are empowered by a high intensity of user engagement and user sourced data. This experience inspired the idea of engaging individuals in managing their health records through personal health systems. The information entered and managed by the users, have a high degree of accuracy and can be effectively used for identifying great patterns through using data mining techniques.

The idea of Blue Button was primary beta-tested by Zoë Baird, the CEO of Markle Foundation, a tax-exempt charitable organization concerned with technology, health care, and national security. The initiative launched at the Department of Veterans Affairs (VA) in 2010 enabled users to gain secure access to their health records through MyHealtheVet Blue Button (Veterans Administration, 2013). It evolved the healthcare services offered by providers who added this feature to their platforms. Consequently, more than 1.7 million users from various platforms utilized this service (Blue Button Plus Implementation Guide, 2013) to download their appointment schedules, prescriptions and medical records, lab results, vital signs, military health history and occupations. A year after, the Office of the National Coordinator for Health Information Technology (ONC) along with the Alliance for Nursing Informatics (ANI) launched a community to encourage individuals' participation in HIT platforms specifically the PHRs (Gibbons et al., 2009). After that, the Department of VA enhanced functionalities of the Blue Button by providing more efficient access to the records, more types of reports, higher usability in a new interface and the capabilities of exporting the health records in the form of PDF ("VA Nebraska-Western Iowa Health Care System," 2008). This movement is promoted by many resources and awareness platforms such as [www.myphr.com](http://www.myphr.com) and [www.allianceni.org](http://www.allianceni.org), nonetheless, the existing level of our understanding about the effective ways in empowering and engaging health consumers is limited (Hull, 2009).

##### **2.4.7.1 Evolution and Maturity**

In 2010, when the Blue Button was launched, its functionality was limited to storing and managing demographic records of the individuals along with their medication data, details of emergency contacts and providers' information. During the next two years, the system received more attention from healthcare providers and insurers and was significantly improved in terms of variety of the records it could maintain and manage (Salah, 2013).

#### ***2.4.7.2 Blue Button Plus***

The Blue button plus was released on January 2013 through collaboration of 68 volunteer companies. In addition to the capabilities of the Blue Button, the plus version is compatible with the machine API standards and at the same time it provides human comprehensible records. Hence, it facilitates automated data exchange and enables advanced record parsing that encourage third parties for adding this feature.

#### ***2.4.7.3 Green Button and Red Button***

The idea of Blue button was expanded to the other areas that could benefit by empowering consumers. Green button provides consumers with their energy usage records in a meaningful and comprehensible format. It has been offered by the Pacific Gas & Electric and San Diego Gas & Electric in California accessible through consumers' Smartphone. This service readily demonstrates the consequence of increasing or decreasing the energy utilization to the users which leads to an efficient consumption (Eaves.ca, 2012).

Fred Wilson, the New York City-based venture capitalist stated that “It [Green button] is a simple standard that the utilities can implement on one side and web/mobile developers can implement on the other side. And the result is a ton of information sharing about energy consumption and in all likelihood energy savings that result from more informed consumers” (Howard, 2012).

Following the successful running of the green button, the red button is a currently under implementation initiative. It aims to engage students in their educational information management by providing their transcripts' records and loan information (Marks, 2012).

## 2.5 Consumer Adoption Factors for PHRs

Patients and potential patients are the primary stakeholders of personal health records. Considering user-centric design of the system, patients are also the most beneficial group among PHRs users. Some studies also suggest high level of consumer satisfaction of personal health records. According to a quantitative research among 688 PHRs users conducted in the Department of Veteran Affairs (VA), 84% of patients believed that PHRs services are helpful for their healthcare (Nazi, Hogan, & McInnes, 2013).

Although the availability of PHRs increases during recent years (Cronin, 2006; Saparova, 2012) and patients have high interest toward using PHRs (Kohler, 2006; Noblin, Wan, & Fottler, 2012), the adoption rate among patients is generally low (Kaelber & Jha, 2008) with the rate of less than 10% of patients who have access to PHRs (Iddleton, Ms, & Ates, 2008).

### 2.5.1 PHRs Impact on Consumer Healthcare

PHRs increase the quality of healthcare services. When physician access to entire historical medication of patient, they are more likely to deliver better healthcare (Wu, Shen, Lin, Greenes, & Bates, 2008). Despite clear effectiveness of PHRs, there is doubt if the desired efficiency among users is provided by the system. Some studies pointed out to usability challenges and complexity of using PHRs which lead consumers to believe using PHRs cannot save time (Tim Bosenick, 2009). In another study (Smolij & Dun, 2006), users believed that PHRs can only be efficient for managing “serious health condition”.

### 2.5.2 Adoption Barriers and Drivers

According to reviewed studies, different factors impact the PHRs consumer adoption. Computer literacy (Nokes, Verkuilen, Hickey, James-Borga, & Shan, 2013) and self-efficacy is a major barrier which defines as one’s confidence in the ability to successfully perform an action (Rimer & Glanz, 2005).

Perceived self-efficacy is defined as “individual's belief in his or her capacity to perform a specific behavior” (Bandura, 2006). In a quantitative study (Luque et al., 2013) most of the patients using PHRs prefer on-site guidance than using online instruction. In order to increase consumers’ confidence in using PHR, patients can be empowered by trial introduction of the system. Offering PHRs trialability to patients needs both facilitating conditions and the availability of the system (Logue & Effken, 2013). According to the definition in Healthy

People, health literacy refers to the degree in which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Kappeler, 2013).

#### *2.5.2.1 Consumer Security, Privacy and Trust*

Information privacy and security is one of the most concerned PHRs adoption factors among consumers. In a survey (Zimenkov & Ahmad, 2012) conducted in 2003, 91% of respondents were identified to be “very concerned” about their information security and privacy. The importance of information security in using PHRs is majorly affected by the outsiders’ ability to access patient’s information in the electronic environment (Smith et al., 2012). A PHRs system might be the subject of different type of attacks. Masquerading attacks including unauthorized use of resources, information disclosure, resources alteration and denial of service is the most common security threat for health systems (Win et al., 2006). In an e-Delphi study over 16 panellists by Logue & Effken, (2013), perceived privacy assurances and security of personal health information were highlighted under the ‘perception of external control’.

Due to the importance of security and privacy, Certification Commission for Healthcare Information Technology (CCHIT) taskforce for major PHRs certification concerns in 2008, indicated information privacy as the most important goal for implementation of the system (Leavitt, Tang, Agrawal, & Benoit, 2008).

Healthcare is a huge value industry that is connected to other businesses such as pharmaceutical companies. According to HIPAA, physicians and healthcare providers should not share patient medical information with unauthorized parties. Therefore, such companies seek for information using indirect methods to identify their and competitors’ consumers (Rakestraw, 2009). Such significant motivation for obtaining patients’ record makes PHRs security a key concern in healthcare industry (Gritzalis & Lambrinoudakis, 2004); Win, 2005).

Despite implementation of security policies and technical safety some issues such as privacy, key management scalability and ease of access remained as challenges to practice secure data access control (Li, Yu, Zheng, & Ren, 2012).

## **Security Enhancement**

Depending on the system, several concerns are common in the practice of health system security development. In order to assure the information security, PHRs must be encrypted before outsourcing (Li et al., 2012). Using some policies such as HIPAA (Liu, Shih, & Hayes, 2011) for Data protection can improve the quality of communication. According to (Delbanco & Sands, 2004), secure e-mail among patients and physicians increase the ease of use and communication quality.

### **Does PHRs Security Overlooked?**

Although people who do not use technology are very concern about security, people who use technology are less so far, if they perceive worthwhile (Cruickshank, Packman, & Paxman, 2012). Some consumers are more concern to the level of convenience associated with using PHRs and the quality of care in its services than protecting privacy (Rakestraw, 2009). In another study by (Lafky & Horan, 2011), patients were less concern about the security of their health information than their financial information.

Generally, most of the patients present higher concern to their privacy. According to the findings of a qualitative study by Curtis, Cheng, Rose, & Tsai, (2011), 43.1% indicated they would like to share access with their family member and 53.5% would like to share access with a physician or other member of their care team. Despite concerns in privacy, very low rate of patients engage in implementing privacy-protecting (Lewis, 2003).

### **2.5.3 Chronic Illnesses (Niche Market and Early Adaptors)**

Chronic diseases are the main cause of around 50% of mortalities in the world (Vita-Finzi & McCarey, 2005). Approximately 75% of elderly people have at least one chronic problem and around 50% of them have more than one chronic disease (Carson & Kavesh, 2000).

Self-management practice and patient contribution in healthcare are two important key activities for management of chronic diseases (Lankton & Louis, 2005). It is vitally important for chronic condition patients to be involved in their healthcare activities (Nokes et al., 2013). PHRs systems are proven to be beneficial to consumers with chronic health problems (Wagholikar, Fung, & Nelson, 2012).

### ***2.5.3.1 Chronics' Openness to Information Sharing***

Chronically ill individuals are the primary target group of personal health record system due to the fact that chronic diseases often has long latency period and continuous monitoring of patients over their health condition (Folker, 2007). Patients with serious chronic conditions often desire to explore all possible ways to treat their disease (Rakestraw, 2009). According to a large scale study by (Lafky & Horan, 2011) individuals with health problems were more interested towards information sharing with other people. The study concluded that 9% of healthy people, 22% of chronically ill patients and 19% of disables have willing to share their information with others. Another study suggests that caregivers to their elderly relatives have the highest interest in using PHRs (Baird, 2003).

## **2.6 PHRs Use Cases**

### **2.6.1 Chronic Condition**

Interactive applications increase perceived social support and patient knowledge in management of chronic conditions (Murray, Burns, & See, 2005). Given the higher prevalence of chronic diseases (Parchman & Pugh, 2007 ; (Christensen, Doblhammer, Rau, & Vaupel, 2009), this can be a valuable advantage for many of chronically ill individuals who do not receive enough care from their primary caregivers (Harrison, Koppel, & Bar-Lev, 2007). A study over chronically ill patients to find perceived PHRs challenges and benefits show that only 16% of respondents perceive that health record provided lab data would confuse them, 5% perceived worry while using PHRs and only 3% believed patients would take offense after introduction of PHRs (Ross et al., 2004).

#### ***2.6.1.1 Challenges of Using PHRs for Chronic Condition***

Despite the benefits of personal health systems for chronic health condition, many patients are not aware of how to effectively use PHRs. A study over cancer patients (Gysels, Richardson, & Higginson, 2007), concluded while patients are interested using PHRs they do not use them effectively. Individuals with cancer can improve their understanding about the therapy schedule, documenting and managing side effects, and interacting with the oncology care team for taking shared decisions by using PHRs (Caligtan & Dykes, 2011).

While PHRs information understanding is often cognitively demanding for elderly users (Field, 1996), it can increase patient empowerment in pregnancy (Wäckerle et al., 2010), diabetes

(Ralston, Revere, Robins, & Goldberg, 2004) or chronically ill malignant hematoma patients (Wiljer, Bogomilsky, & Catton, 2005).

### **2.6.2 Remote Patient Monitoring**

Technological tools and electronic devices improve and facilitate required monitoring even when the users are staying at home (Green et al., 2008; Lemelin et al., 2008). Remote Patient Monitoring (RPM) or “using technology to manage, monitor, and treat a patient’s illness from a distance” (Iwaya et al., 2013) is an evolving concept with the purpose of healthcare cost reduction for patients as well as service providers, and also increase the accessibility of health services for people in need (Rajkumar, 2009). Remote monitoring of chronic diseases has been indicated as a part of Integrated Personal Health Services (IPHS) program (Baum et al., 2013). In 2012, 308K individuals have been estimated to use RPM for managing their health conditions such as mental situation, diabetes, heart failure and chronic obstructive pulmonary disease across the globe ((Johnson, Sohn, & Inman, 2013).

Remote Patient Monitoring services has been evolved from standalone systems to integrated applications that enable communication (sometimes in the form of visual and audio) (Lindeman & Redington, 2010) with caregivers and service providers mostly through wireless technologies (Kelpin, 2014). Popularity of distance care caused an intensive RPM device market growth in recent years (Ball, Smith, & Bakalar, 2007).

Remote services are widely offered through mobile phones (Iwaya et al., 2013) which have had created a paradigm for remote healthcare (Oliver & Flores-Mangas, 2006).

RPM has been mainly designed to track individuals’ vital signs like blood pressure, heart rate, blood glucose and etc (Baum et al., 2013) and prevent the risk of unnecessary readmission (Lindeman & Redington, 2010). The RPM market is estimated to expand as baby boomers growing up and better care services are provided, if the business could be financially justified (Ball et al., 2007).

While some vendors (Clarke et al., 2005) focus on delivery of RPM services through mobile devices, PHRs remote monitoring services are designed to assist preventive actions and chronic care (Kelpin, 2014) in an efficient way (Ball et al., 2007) leading to cost reduction (Kelpin, 2014; Dimmick & Burgiss, 2003) (e.g. Reducing rehospitalization) (Patient & Diffusion, 2013). Using PHRs has been proven to reduce the hospital readmissions (Lindeman & Redington, 2010). In the US, the 18% hospital readmissions rate could be prevented in 76% of the cases

(Jencks, 2009). Efficient integration with caregivers, better quality of care and long term healthcare cost reduction could motivate patients to use PHRs remote monitoring for their health management.

### **2.6.3 Maintain Medical History (e.g. emergency)**

Health Information Exchange (HIE) or transferring prompt information has been proven to increase the quality of care (Weaver, S. et al. (2011). A group of individuals use personal health systems just to maintain their medical records for future needs. In a study, more than 93% of the respondents were positive to share their information with emergency room if required. Among them more than 70% were also agree to share their records with nurses and medical technicians (Lafky & Horan, 2011).

Maintaining records for emergency cases is a common function in PHRs. In American Association of Kidney Patients (AAKP) MyHealth for instance, patients might update their records through “My Health Information” which is designed for maintaining the data in a flexible way not only to handle emergency situations, but for pharmacies to ensure reliable medication refills (Buettner & Fadem, 2008).

Current PHRs are mostly stand-alone applications that might be limited in many functions but can be accessed and used for emergency cases (Vishwanath, 2009). Sharing information in PHRs is sometimes designed as “Break the Glass” feature which can authorize emergency healthcare service providers to access health records if activated by users (Screen, 2011). In addition to emergency situations like a natural disaster, a PHRs system can maintain records of allergies, immunizations and even geographical locations that might cause health problems (Screen, 2011).

#### **2.6.4 Personal Health Diary**

Managing health related diary is a subset of “person-centered” set of health information requirements (Helena & Katri, 2012). It is normally sourced by patients rather than health organizations (Barlow, Crawford, & Lansky, 2008).

Such type of data, including diet, quality of sleep and exercise, called the “Observations of daily living” (ODL) (Perlich, 2012), is not often semantically interoperable and thus cannot be shared effectively (Hietala, Ikonen, & Korhonen, 2009). An example of applications supporting personal diary can be seen in “NoMoreClipboard” enables individuals to set reminders for submission of their diary data (Hie-populated, 2011).

#### **2.6.5 Inherited Disease Monitoring and Prevention**

Tracking genetic information for diagnostics and prevention of diseases has been mentioned as an action point in reinventing healthcare (Hietala, Ikonen, & Korhonen, 2009). The understanding of genetic influence on appearance of health issues can be more rapidly developed if genetic information could be integrated with familial data stored in EMRs (Kmiecik & Sanders, 2009).

Celiac disease can be a good example of problems that tightly depends on first degree relatives’ background with the rate of 5 to 15 percent (Cranney et al., 2007). Similarly, ovarian cancer familial effect from mother, sister, or daughter could be observed through such integration (Kmiecik & Sanders, 2009).

Table 8 summarizes the five discussed use cases of PHRs. It also shows how the three main group of stakeholders benefits from the system in any of the reviewed scenarios. Finally, the table listed the main activities that users should accomplish for managing their conditions.

**Table 8: PHRs Use cases**

| Conditions                                  | Categories                                | Illness |           | Risk Factors |        |          | Benefits                                       |                                                                |                                            | Relevant Functionalities                                      | User Tasks                                                 |
|---------------------------------------------|-------------------------------------------|---------|-----------|--------------|--------|----------|------------------------------------------------|----------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------|
| Use Cases                                   |                                           | Healthy | Unhealthy | No Risk      | Medium | Elevated | Patient                                        | Physician                                                      | Provider                                   |                                                               |                                                            |
| Remote Patient Monitoring                   | Personal Health Monitoring and Management |         | √         |              |        | √        | - Reduce cost<br>- Reduce readmission risk     | -Enhance diagnostic<br>Quick response                          | - Reduce labor<br>- Less rehospitalization | - Device Integration<br>- Vital Sign Tracking                 | -Share data and Modify Lifestyle                           |
| Chronic Illnesses                           | Patient-Provider Communication            |         | √         |              |        | √        | - Reduce cost<br>- 24/7 communication and care | - Ease of communication<br>- Share the risk of decision making | -Eliminate duplication of tests            | - Information Integration<br>- User Interaction               | - Share data<br>- Modify Lifestyle and follow instructions |
| Maintain Medical History                    | Personal Health Journal                   | √       |           |              | √      |          | -Enhance emergency management                  | -Enhance quick decision making                                 | -Immediate access to records               | - Record Keeping<br>- Effective data Retrieval                | -Share data only in emergency events                       |
| Personal Health Diary                       | Personal Health Reminders                 | √       |           | √            |        |          | -Easy management of ODL data                   | -                                                              | -                                          | - Scheduling and Reminders<br>- Task Management               | -Personalized management                                   |
| Inherited disease monitoring and prevention | Personal Decision Support                 | √       |           |              |        | √        | -Effective diagnostic or prevention            | -Enhance diagnostic                                            | -Eliminate or reduce duplication tests     | - Familiar Integration<br>- Demonstration of relative degrees | -Share data for preventive or diagnostic decisions         |

## 2.7 Physicians' Acceptance of PHRs

Physicians are primary influential group of health professionals in the adoption and patient involvement of PHRs (Fuji, Galt, & Serocca, 2008). In this study, the term “physician” has been used as licensed professionals to practice medicine.

Despite benefits of personal health records in delivering quality care services which will briefly discussed in the next section, studies show that the PHRs adoption rate among physicians is low (Jeffs & Harris, 1993). A survey (Royal College of Physicians and Surgeons of Canada, 2013) conducted in Quebec, indicated that the rate of family physicians using PHRs in order to access patients' clinical record is only 21%. As indicated in a qualitative study, healthcare providers have more concern toward challenges (64.6%) than benefits (34.4%) associated with using PHRs (Hatton, Schmidt & Jelen, 2012).

### 2.7.1 PHRs Impacts on Physicians' Services

Integrated patient-centric architecture of personal health records causes positive and negative changes in the physicians' health services both in the way of delivery and quality of outcome. Personal health records can limit the medical errors in healthcare services (Kronick, 2000). For instance, lack of access to complete prescription records might increase the risk of patient's drug interactions (Polzin, 2008).

In addition to the advantages of integrated patients' information to the quality of health services, personal health record improves the relationship between healthcare professionals and health consumers (Unruh & Pratt, 2007). This communication improvement has a huge positive potential since most of the activities in healthcare has collaborative and communicative nature (Kim, 2013). In a study by Ross, Moore, Earnest, Wittevrongel, & Lin, (2004), 68% of respondents believed that PHRs systems increase the level of consumers' trust in their healthcare service providers.

## **2.7.2 Physicians' Adoption Factors**

### **2.7.2.1 Lack of Adequate Knowledge**

The low acceptance rate among health professionals and especially physicians can be partially explained with limited knowledge of personal health records (Fortney, Burgess, Bosworth, Booth, & Kaboli, 2011; Wynia, Torres, & Lemieux, 2011). Primarily, health care professionals do not have required level of knowledge of PHRs features and functionalities (Kim, 2013). Therefore, they cannot properly educate and support their patients and accelerate the PHRs adoption among customers.

### **2.7.2.2 Extra Unreimbursed Workload**

Using PHRs in physicians' point of view could make additional workload because health professionals need to deal with higher volume of information and new patient communication channel. Several studies suggest that the level of physicians' reticent to accept personal health records in compare with other groups of healthcare professionals is higher mainly for avoiding higher uncompensated workload associated with PHRs functions (Jones et al., 1999; Baird, 2003). In a survey panel by Clarke et al., (2005), one of the members stated that "Even if physicians are persuaded to extract information from a PHR, it will be difficult to convince them to enter information without appropriate incentives". Kaelber & Jha, (2008) pointed out to additional unreimbursed workload as the major physicians' concern in personal health records adoption (Kaelber & Jha, 2008). Adequate and appropriate incentive is one key factor in physicians PHRs adoption. Some studies believe that without enough compensation, widespread adoption of PHRs will not occur in physician community. An economic cost-benefit consideration is a major acceptance factor among healthcare providers (Dolan et al., 2009).

### **2.7.2.3 Standards**

Healthcare is a mature established industry with defined standards and routines. Engaging in technology for healthcare information management requires the alignment of IT systems with healthcare standards. Without a proper standard in PHRs, most of physician practices will not spend time and effort in learning diverse formats of different systems (Dolan et al., 2009).

## **Health Level Seven (HL7)**

Health level seven is a non-profit organization founded in 1987 that establishes the HIT standards and frameworks for the purpose of information exchange and sharing in more than 30 countries in the world (Ribick, 2011).

In 2007, HL7's PHRs functional model has been approved by the organization. This model defines what functions need to be designed in PHRs systems and is applicable to some specific models (stand-alone, web-based, provider-based, payer-based, or employer-based models) (Arbor, 2007).

Later in 2011, "Plan-to-Plan Personal Health Record Data Transfer Implementation Guide" was released by HL7. P2PPHR enables users to transfer their records when shifting from a specific type of coverage to another type in a secure and consistent manner (Ribick, 2011).

#### **2.7.2.4 Control**

Healthcare providers prefer to gain higher control over medical records. Therefore, higher perceived independency in using PHRs will lead to higher degree of intention to use among physicians (Hung, Ku, & Chien, 2012). In contrast, perceived patient control over their medical records can make physicians nervous (Rakestraw, 2009). Although developing access control policies for a better security and privacy can increase physicians control over the health information, it might also prevent physicians accessing to the required health information (Kimmel, Greenes, & Liederman, 2004; Lafky & Horan, 2011; Maloney & Wright, 2010).

Introducing information technology tools increase healthcare professionals' "perceived loss of control" over the way they medicate patients (Katerndahl, Parchman, & Wood, 2009). In a survey by Hatton, Schmidt, & Jelen, (2012) the major challenge for physician adoption to PHRs was indicated as "Loss of Control".

#### **2.7.2.5 Resistance to Change**

Physicians resist changing their work style resulting from using personal health records systems (Hatton, Schmidt & Jelen, 2012; Clarke, Meiris, & Nash, 2005). They are not ready to accept what designed for them as the "optimum" and wait for technology to get align with their working style (Hatton, Schmidt & Jelen, 2012). Like any implementation and introduction of new information technology, PHRs development should be supported with appropriate change plan.

#### **2.7.2.6 Other Barriers**

In a research of PHRs physicians' adoption factors using UTAUT model, "Expected Performance", "Facilitating Condition" and "Social Influence" had the greatest impact on using the system by doctors (Ekta, 2010).

#### **2.7.3 Integration Challenges**

One of the most important characteristics of personal health records systems is its integrated architecture which eventually increases the capabilities to present significant volume and quality of information. A significant amount of health information stored in PHRs is directly obtained through patients' data entry. Patient-entered-information is not trusted and reliable enough for most of the physicians (Archer et al, 2011). For instance, most of physicians believe that web-based PHRs should be completely separated from EHRs due to the lack of accuracy in patient entered records (Win et al., 2006). Since PHRs information provided to healthcare professionals is unprocessed, it should be analyzed to make sure that using such information does not create new medical error risks (Liu et al., 2011).

##### **2.7.3.1 Integration and Security**

Integration of PHRs systems with EHRs raises the security concerns for physicians. When an EHRs system integrates with another system such as PHRs, the level of access to the information will be increased and eventually EHRs will be more vulnerable to security breach. In order to prevent unauthorized access, most of healthcare centers are using firewall and data encryption and secure protocols like HTTPS for their online health systems (Win et al., 2006). Although web-based PHRs are vulnerable to interferences and network security threats, using 128-bit encryption significantly increase the health information protection.

## **3.0 Research Design and Methodology**

In this chapter two main steps used in designing the research and its methodology are introduced. First, we discuss existing theories and studies that form the basis of the theoretical model including the cognitive theoretical concept. In the next part, the survey design and its procedures are reviewed. This section is supported by an evaluation of a selected research method and planning for different analysis steps. The primary goal of this study is to investigate individual and organizational factors affecting the use of patient-facing information systems for managing health records. Toward this end, the possible relationships among these factors are discussed.

### **3.1 Theories Used in Formation of the Research Theoretical Model**

The Social Cognitive Theory (SCT) and the Technology Acceptance Model (TAM) are used in designing the research model in this study. In a holistic view, this research examines the influential factors in using PHRs. Specifically, this work proposes and validates a suitable model to explain PHRs adoption factors in Canada.

#### **3.1.1 Technology Acceptance Model (TAM)**

Based on the Theory of Reasoned Action, Davis (1989) developed the Technology Acceptance Model (Figure 3) to find out what factors cause people to accept or reject using an information technology system. He suggests that Perceived Usefulness and Perceived Ease of Use are the two most important individual beliefs about using an Information Technology.

Perceived Usefulness is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” and also Perceived Ease of Use is defined as “the degree to which a person believes that using a particular system would be free of effort” (Li, 2010). These two behavioral beliefs lead to individual behavior intention and actual behavior. Davis (1989) finds that Perceived Usefulness is the strongest predictor of an individual’s intention to use an information technology.

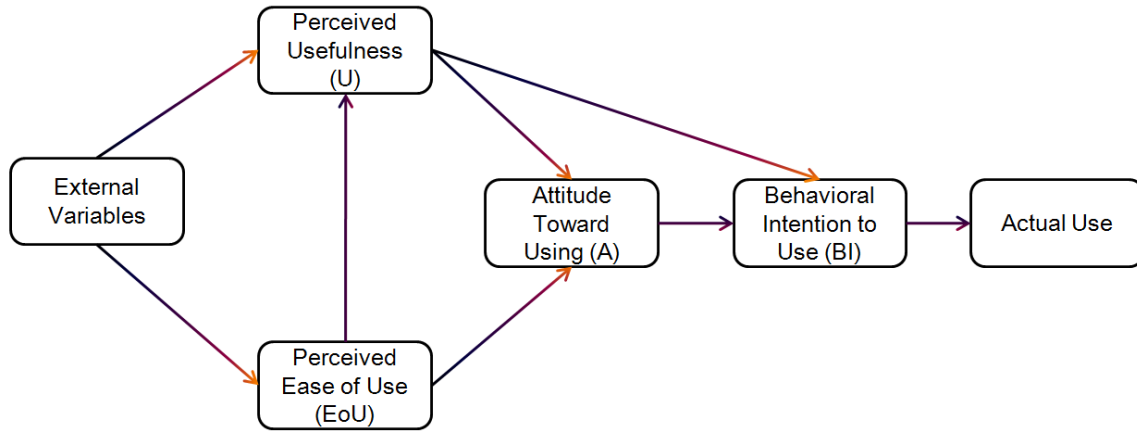


Figure 3: Technology Acceptance Model (TAM)

Perceived Usefulness and Perceived Ease of Use of the users in an information system is believed to positively affect their attitude and intention towards using that system. The higher intention to use an information system then increases the actual system usage by its users. These two components of the model (Perceived Usefulness and Perceived Ease of Use) could be affected by many external variables in a direct or indirect way.

TAM is stated to be the most used theory in the studies of IT products acceptance (Ma & Liu, 2004; Kim & Chang, 2007; Yarbrough & Smith, 2007). The theory has been frequently tested in many studies of information technology applications as well (Chau & Hu, 2001, Lee, Kim, Rhee, & Trimi, 2006, Raitoharju, 2007). Moreover, the reliability and explanatory power of Technology Acceptance Model (TAM) has been validated by numerous empirical research studies (Davis, Bagozzi, & Warshaw, 1989); Mathieson, 1991; Yarbrough & Smith, 2007). TAM is very useful for ex post facto studies (Lafky & Horan, 2011) and enhances researchers to measure the predictor variables of user intent and user behavior (Price, 2010).

Specifically, TAM is widely accepted among researchers of the HIT. It have been used for determining what features and functions should be designed in a health IT system (Kim & Chang, 2007; Bickmore et al, 2010; Jung, 2008). (Calvin & Karsh, 2009) reviewed the Patient Acceptance of Consumer Health Information Technology in the context of the Technology Acceptance Theory.

Due to the frequent using of TAM in IT applications in the health industry, it seems to be appropriate for explaining the user behavior towards patient centered platforms. In a more specific view, the theory is validated in many healthcare studies (Chau & Hu, 2002a; Chau & Hu, 2002b; Chismar & Wiley-Patton, 2003; Phichitchaisopa & Naenna, 2013). Some studies TAM in the adoption of HIT systems (Nyanza & Gilbert, 2013; (Dünnebeil, Sunyaev, Blohm, Leimeister, & Krcmar, 2012) extended the use of TAM to the ambulatory and E-health studies for e-health applications. Eventhe model is used in mobile services studies (Sun & Wang, 2013).

According to the reliability and validity of the theory for CHI studies and specifically user-centered information system adoption, the theory seems to fulfill the high degree of appropriateness required in this study.

### 3.1.2 Social Cognitive Theory (SCT)

SCT is considered as an appropriate theory for health related studies. The theory not only deals with the cognitive, emotional and biological aspects of individuals to explain their behavior, but is also appropriate for investigating individuals' psychology. Assessing the behavior of individuals is based on individual and environmental factors.

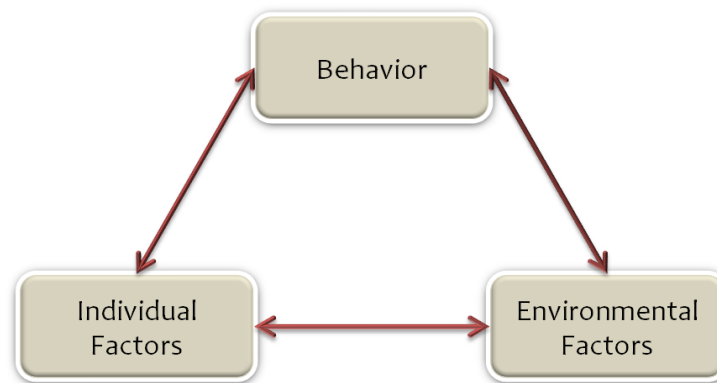


Figure 4: Social Cognitive Theory (SCT) Components

Individual factors are peoples' instincts, drives, traits, and other individual motivational forces (Jaars, 2013) and "Environmental factors" are situational influences on personal behavior. Environmental factors are classified into "Technological factors" which represent the system properties and development and "Organizational factors" that associate with the system providers. All the three components of the SCT, individual, environmental and organizational,

influence each other concurrently and none of them can be explained only by the other two (Figure 4).

Social Cognitive Theory is widely used in various research topics. It has been used to determine the consequences of choices made by individuals and is formulated in many concepts such as the Observational learning, Self-regulation, Incentive motivation, Self-efficacy - confidence and ability to perform behaviors (Allison & Evason, 2013). In SCT, human behavior is explained in two-way and dynamic interactions of personal, environmental, and behavioral factors. Hence, physical activity behavior is considered in a dynamic and interactive system (Peyman, Esmaily, Taghipour, & Mahdizadeh, 2013). According to Bandura, (1986), human will take an action that has a personal cognition in the social environment.

Self-efficacy is one of the major components of the SCT which is defined as the belief in one's capabilities to produce desired results by one's actions. It is proven to have positive effect in health domain areas (DiClemente, Prochaska, & Gibertini, 1985). It is also evident that those with the higher confident of being able to accomplish health management activities are in a better health condition to dependent groups (Rohrer, Arif, Denison, Young, & Adamson, 2007; Hildebrand et al., 2012)

The theory used for prediction of individuals' behavior in health related topics (Bandura, 2004; Bandura, 1991; Bandura, 1989) such as the neuroscience (Lieberman, 2010; Jarcho, Berkman, & Lieberman, 2011) or predicting individuals' physical activities (Martin & McCaughtry, 2011). According to (Bandura, 2004), SCT "specifies a core set of determinants, the mechanism through which they work, and the optimal ways of translating this knowledge into effective health practices".

In addition to the studies that focus on predicting user behavior, SCT has been utilized for investigation of the IT products specifically in health industry. It is used to determine the Bundles of Features in a Web-Based Personal Health Management Systems (Lau et al., 2013) and demonstrated validity.

Also, in the domain of CHI, SCT has been validated in many studies such as (Kijisanayotin, Pannarunothai, & Speedie, 2009; Brown, 2012). The theory is specifically expanded to the adoption of PHRs in different studies (Kijisanayotin, Pannarunothai, & Speedie, 2009; Assadi & Hassanein, 2009).

Since the patients should take decision on using the system while they should interact with the healthcare environment through the system using the theory to the studies on the adoption of PHRs seems to be appropriate. The SCT in this research aims to predict consumers' behavior towards using the PHRs considering the impact of their environmental factors, in the organizational and technical level, as well as their own individual traits.

Combination of both theories, the TAM and SCT provides the opportunities for identifying the external variables affecting the adoption of PHRs systems in the individual, technical and organizational layer and eventually outline the actions that could accelerate the user acceptance if implemented in each layer.

### 3.2 Research Proposed Theoretical Model

Built on the previously mentioned theories, the following theoretical model has been formulated to achieve the objective of this research study. This model is developed from the major constructs that generate strong behavioral forces in forming users' behavior. The constructs, dimensions and paths appear in the model along with the justification of forming each path and the propositions made are discussed in the next section.

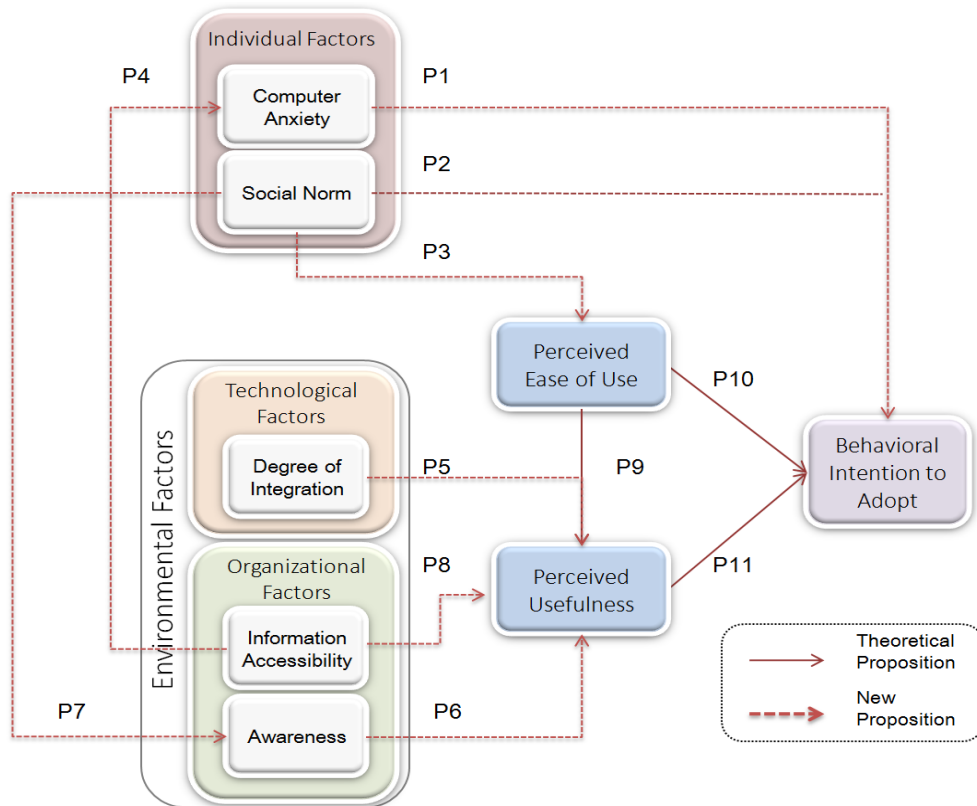


Figure 5: Research Proposed Theoretical Model

The aim of evaluation of the empirical model is to answer our research question about what are the interrelationships among technical, organizational and personal factors that affect the adoption and use of PHRs systems. For this purpose, we investigate the relationships that might occur between individual attributes, technological factors, organizational policies and procedures, in the context of TAM in this part of the research.

As posited in the model, the Computer Anxiety and Social Norms are proposed to individual layer, affect Intention of Using PHRs through forming direct and indirect relationships. The relationships of the environmental factors including the Degree of Integration, Information Accessibility and the User Awareness are also examined in our empirical model.

### 3.2.1 Proposed Constructs' Dimensions and Paths

#### 3.2.1.1 Individual Factors

The first dimension of the model is individual factors and encompasses two constructs: Computer Anxiety and Social Norms. These constructs have the three following propositions.

Table 9: Path Propositions and validations (Individual Factors)

| Proposition | Model Path                                                                                         | Basis in Extant Literature                                                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P1          | Higher level of computer anxiety reduces the users' intention to use PHRs.                         | Igbaria & Chakrabarti (1990) suggested that the Computer Anxiety affect the Behavioral Intention of individuals.                                                                                          |
| P2          | Higher level of Social norms of the system increases the customers' intention to using PHRs.       | (Ajzen, 1991) in development of the Theory of Planned Behavior suggested that Social Norms affects the Behavioral Intention of individuals.                                                               |
| P3          | Higher level of Social norms of the system enhances the customers' Perceive Ease of Using of PHRs. |                                                                                                                                                                                                           |
| P7          | Higher level of Social norms increases the customers' Awareness about PHRs.                        | A change in Social Norms typically begins with public apathy and requires an increase in public Awareness in order to achieve the social concern necessary to address the problem (Francis et al., 2010). |

#### 3.2.1.2 Technological Factors

Second dimension of the model is the environmental factors (Technology) that is made up of a single construct called the Degree of Integration. The Degree of Integration form a proposition with the Perceived Usefulness presented in the Table 10.

Table 10: Path Propositions and validations (Technical Factors)

| Proposition | Model Path                                                                                                                                           | Basis in Extant Literature                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| P5          | Interoperability and compatibility (better integration) with other Healthcare IT systems have positive influence on customers' intention to use PHR. | Lack of system integration is identified as systemic issues in IT adoption (Raza & Standing, 2008). |

### 3.2.1.3 Organizational Factors

The third dimension, environmental factors (Organization), has two constructs called Information Accessibility and Awareness. These constructs form three propositions presented in the following table.

Table 11: Path Propositions and validations (Organizational Factors)

| Proposition | Model Path                                                                                                              | Basis in Extant Literature                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P4          | Better Information Accessibility of PHRs users will have a negative relationship with their perceived Computer Anxiety. | HIMSS envisions ePHRs that are universally accessible and layperson comprehensible (Bell, Halley, Casey, Schooler, & Zaroukian, 2007).                                                                                           |
| P6          | Higher Awareness about PHRs among users corresponds with higher user Perceived Usefulness of the system.                | Lack of awareness is noted in usability studies of PHRs as an important factor for explaining the user behavior (Xie, Rooholamini, Pearson, Bergman, & Winograd, 2013).                                                          |
| P8          | Higher Information Accessibility of PHRs corresponds with higher user Perceived Usefulness of the system.               | The paper found comprehensiveness and relevance to be the most effective components of the argument quality construct of the research model, making them key influencers of information adoption (Cheung, Lee, & Rabjohn, 2008). |

### 3.2.1.4 Technology Acceptance Factors

Researchers have discovered that Perceived Usefulness and Perceived Ease of Use have a positive influence on the individual's Intention to Use the enterprise system, subsequently leading to greater actual use of that system (Davis et al., 1989).

Table 12: Path Propositions and validations (Technology Acceptance Factors)

| Proposition | Model Path                                                                                                            | Basis in Extant Literature                                                                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| P9          | Higher level of Perceived Ease of Using of PHRs among individuals increases their Perceived Usefulness of the system. | Perceived Ease of Use and Perceived Usefulness are of primary relevance for computer acceptance behavior (Davis et al., 1989). |
| P10         | Higher level of Perceived Ease of Using of PHRs among individuals increases the customers' intention to using PHRs.   |                                                                                                                                |
| P11         | Higher level of Perceived Usefulness of the system among the users increases their intention to using PHRs.           |                                                                                                                                |

### **3.3 Research Design and Method Appropriateness**

Research design is defined as a plan describing the data collection and the analysis methods (Parahoo, 1997) or a method for answering research questions (Polit et al., 2001). A major step in research design is to choose an appropriate methodology. Research method specifies practical steps to data collection and analysis (Draper, 2004). Two common classification of methods are identified as qualitative and quantitative (Sukamolson, 2012). Selecting the right methodology should be according to their suitability to the research context, purpose and nature of the study (Bryman & Burgess, 1999).

The quantitative approach is adopted for this research. It uses quantitative measures of a target sample and describes the results for the whole population. This method has a greater power of presentation with charts, graphs and etc (Weidemann & Fitzgerald, 2008). Moreover, quantitative method is recommended by Cohen and Manion (1980) for conducting social studies.

#### **Advantages of Quantitative Research for This Study**

Using quantitative approach for this research fits the objective of the study which is to quantify the individual's attitudes towards using patient-facing information systems. According to Burns & Grove (2005) this method is appropriate for studies that describe variables and highlights the relationships among them. Quantitative approach is recruited for measuring and testing those relationships for this study. One other justification behind using this method is that previous similar studies could be then compared to the findings of this research. Moreover, future studies with quantitative approaches could also be easily compared with this study.

### **3.4 Survey Instrument Design and Data Collection**

Examination of the findings in a quantitative method is conducted through a survey among healthcare consumers and is analyzed by the Partial Least Square (PLS) as a suitable soft modeling analysis method (Tobias, 1994). Conducting surveys enable researchers to have a clear interpretation of the relationships among variables (Alshumaimeri, 2001). Using an electronic survey expands the capabilities of design and modification of the content, reaching to the targeted sample, and also further data collection and analysis (Alshumaimeri, 2001). It also enhances the cost effectiveness and time management that are the two critical aspects of this study.

In addition to demographic and frequency required from the respondents, the survey encompasses psychographic questions measuring latent variables by scoring on a 7-point Likert scale designed through Electronic survey online application. Likert scale is defined by LaMarca (2011) as “an ordinal psychometric measurement of attitudes, beliefs and opinions.” The survey questions are designed based on the previously validated item scales in similar studies. A pre-testing of the survey is conducted to ensure that the scales and questions are reliable and organized for further analyzes and interpretations.

Beside study relevant literature and materials, the data collection is conducted through an electronic (online) survey questionnaire targeted at potential and actual end-users of PHRs. The online survey was created and administered through the Qualtrics survey software suite hosted at the Telfer School of Management, University of Ottawa.

### 3.4.1 Construct Measurement Items

The nature of measurement has been developed to explain how the concept of this study will be validated through the theoretical model. The scales are designed to clearly specify required measures in designing survey questions.

Table 13: Nature of Measurement

| Concept                         | Operational Concept                      | Criteria                             | Indicants                     | Scale                                    |
|---------------------------------|------------------------------------------|--------------------------------------|-------------------------------|------------------------------------------|
| Information Technology Adoption | Personal Health Record Consumer Adoption | Patient Factors                      | Perceived Ease of Use         | Consumer Ease of Using the System        |
|                                 |                                          |                                      | Computer Anxiety              | Consumer Anxiety level                   |
|                                 |                                          |                                      | Social Norms                  | Society Subjective Norm                  |
|                                 |                                          |                                      | Behavioral Intention To Adopt | Technology Acceptance Rate               |
|                                 |                                          |                                      | Perceived Usefulness          | Degree of Perceived Usefulness           |
|                                 |                                          | Environmental Factors (Technology)   | Degree of integration         | Perceived Consumer Integration Level     |
|                                 |                                          | Environmental Factors (Organization) | Information Accessibility     | Degree of User Information Understanding |
|                                 |                                          |                                      | Awareness                     | Level of Consumer Awareness              |

Table 14 illustrates the items designed to reflect users' responses towards each construct.

Table 14: Measurement Items for model constructs

| Construct                     | Measurement Items                                                                                                                                                                                                                                                                                                                        |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Perceive Ease of Use          | <ul style="list-style-type: none"> <li>- I believe Personal Health Record system is easy to use.</li> <li>- I found it easy to interact with PHR systems.</li> <li>- I believe using PHR is easy to learn.</li> </ul>                                                                                                                    |
| Computer Anxiety              | <ul style="list-style-type: none"> <li>- I would hesitate to use an Electronic Personal Health Record system for fear of making mistakes I cannot correct.</li> <li>- I feel nervous to use computer for accomplishing a task.</li> <li>- When I use a computer, I have fear of damaging the machine.</li> </ul>                         |
| Social Norms                  | <ul style="list-style-type: none"> <li>- This is common in society for individuals to maintain their health record in PHRs.</li> <li>- I believe using Personal health record is normal in today's society.</li> <li>- Using PHR considers a normal health management practice.</li> </ul>                                               |
| Behavioral Intention to Adopt | <ul style="list-style-type: none"> <li>- If an Electronic Personal Health Record is made available to me, I intend to use it.</li> <li>- I prefer to use PHR system for keeping my health records up to date.</li> <li>- As far as possible, I will use the PHR system to manage my health information in future.</li> </ul>             |
| Perceived Usefulness          | <ul style="list-style-type: none"> <li>- I believe the Electronic Personal Health Record is useful to manage health conditions.</li> <li>- Using Electronic Personal Health Record has a lot of advantages in my health management.</li> <li>- PHR systems are capable of providing benefits to individual health management.</li> </ul> |
| Degree of Integration         | <ul style="list-style-type: none"> <li>- I can access to my entire health records using PHR.</li> <li>- My Personal Health Record system is integrated with other EHR systems.</li> <li>- My personal health system is integrated with other systems that keep my health records.</li> </ul>                                             |
| Information Accessibility     | <ul style="list-style-type: none"> <li>- I can communicate to my physician through my PHR system.</li> <li>- I understand my health records presented in PHR.</li> <li>- Information presented in Personal Health Record is clear to understand.</li> </ul>                                                                              |
| Awareness                     | <ul style="list-style-type: none"> <li>- I am aware of Electronic Personal Health Record system as a self-health management tool.</li> <li>- I already know what the PHR is and how it works.</li> <li>- I have enough information in order to decide using PHR for my health management.</li> </ul>                                     |

### **3.4.2 Design Consideration and Validity of the Survey**

Validity of the research is considered an essential requirement of the study since it ensures the survey measures what it is supposed to measure (Alshumaimeri, 2001). As recommended by Andrews, Nonnecke & Preece (2003), guideline from the similar studies are followed for conducting the survey in this study. For this purpose, the survey questions and the items are adopted from similar studies. According to Bagozzi (1996), this method validates the survey measurement.

Likert questions are proven to be easy to construct and having a highly reliable scale (Kothari, 2003). In addition, it gives the respondents a neutral feeling and a higher chance of answering questions while it can be easily administered by the researcher (LaMaraca, 2011). Likert scale is presented with odd numbers followed up from the previous studies.

### **3.4.3 Survey Pre-Test Procedure**

The main objective of doing the survey pilot is to ensure that it is error free. This step has been identified as an important action that verifies adequacy of the planned data collection (Andrews et al., 2003; Preece et al., 2002).

Survey pilot is conducted in two rounds. First, the survey is evaluated by the researcher's supervisor and enriched from his extensive experience of designing and supervising similar efforts. The survey instrument is improved in terms of wording, logical sequencing and lengths of questions consequently. In the second round, the survey was examined for 20 individuals from the principal researcher's social network. This stage revealed few areas for further improvement of the survey. The data records gathered in this stage were not used for the analysis of the study.

## 3.5 Data Collection and Survey Administration Procedures

### 3.5.1 Sampling Frame

Sampling is a data collection method to choose a representative selection (Latham, 2007) and generalizing the results to the whole population (Trochim et al., 2006). In this study, a diverse cross-section approach, recommended in many empirical studies, is utilized (Andrews et al., 2003; Preece et al., 2002; Ridings & Gefen, 2004).

Convenience Sampling is adopted to involve accessible participants that desire to contribute in the study (Trochim et al., 2006; Teddlie & Yu, 2007). Since this study is concerned with researching potential consumers of PHRs, on the outset, everybody can be considered to be a potential consumer. Therefore, despite its shortcomings, convenience sampling technique was utilized to obtain responses from anyone who was interested in learning and talking about this technology. Specifically, in this study potential and actual users of PHRs in Canada are targeted. Participants were sought from various active health forums and online communities.

### 3.5.2 Sample Size Requirement

Survey is conducted with the data gathered from the current and potential PHRs end-users in Canada. In order to determine valid sample size for PLS, the maximum path numbers in the most connected construct must multiply by 10 (Chin, Marcolin, & Newsted, 2003). In this research, “Perceived Usefulness” is the most connected construct with 5 paths. Therefore, validation of the model requires minimum of 50 samples. Accounting for not-responded and incomplete results in the range of 40%, a sampling frame of 130-150 responses within the duration of our designated data collection period is aimed. A sampling frame of this size helps establishing statistical validity of the statistical analysis results.

Min sample size calculation (N):

$N = \text{Max} (10 * \text{max no. of antecedents affecting a consequent in the research model},$

$10 * \text{max no. of items in a latent variable})$

$= \text{Max} (10*5, 10*8) = \text{Max} (50, 80)$

$= 80$

### **3.6 Data Analysis and Reporting Procedures**

In this section, various analytical techniques and methods are recruited for data analysis. In the first step, demographic and technographic moderator variables are numerically and visually presented. Next, the relevancy of the explanatory constructs in the model are validated and overviewed. Lastly, the Structural Equation Modeling (SEM) is critically examined for the overall testing of the empirical model.

#### **3.6.1 Demographic and Technographic Analysis and Reporting**

Statistical analysis of the Demographic and technographic questions is conducted by Descriptive Statistics and Nonparametric Statistical Tests. Descriptive Statistics is designed to arrange, summarize, and present a set of data in a specific way to produce useful information by graphical techniques and numerical measures (Keller, 2007). In addition, Microsoft Excel 2010 is used for calculating and presentation of the survey results. Nonparametric Statistical Tests which include binomial and chi-squared are suitable for nominal or ordinal data (Zhao et al, 2012). They compare the propositions associated with various categories on different variables. The tests are specifically powerful tools where distributional assumptions with parametric procedures cannot be met (Green & Salkind, 2003).

#### **3.6.2 Exploratory Factor Analysis (Measurement Validity and Construct Dimensionality)**

Prior to the SEM, the validity of measurement items is testified by the exploratory factor analysis. It is defined as “a statistical procedure used to uncover relationships among many variables” and enables numerous inter-correlated variables to be condensed into fewer dimensions called factors (Velicer & Jackson, 1990). In this study, factors represent the degree of agreement with the statements designed in the survey regarding the individuals’ perceptions, preferences and beliefs of using PHRs.

##### **3.6.2.1 Procedures for Extraction and Rotation**

In order to analyze the model, factor rotation type, number of used factors and the extraction method should be considered. The common factor analysis or Principal Axis Factoring (PAF) is used in this study. PAF seeks the minimum number of factors for common correlation among different variables and does not depend on distributional assumptions of multivariate normality (Mercer, 2013). It considers a high interpretable solution for exploratory studies (Coughlin & Knight, 2007; Fabrigar et al., 1999). Promax rotation which is derived from

procrustean rotation is used in this study as a fast and conceptually simple solution that tries to fit a target matrix with a simple structure (Abdi, 2003; Fabrigar et al., 1999). It enables correlation among factors representing attitudinal and belief dimensions (Norusis, 1990). Considering the number of factors in the analysis, in order to determine the dimensionality of factor space, screen cut-off points suggested by Velicer and Jackson (1990) is used as the general guide.

### ***3.6.2.2 Assessment Criteria for Item Validity and Construct Dimensionality***

The loading of each item on the associated construct should exceed the value of 0.7 (Nunnally, 1978) or at least exceed the acceptable value of 0.6 for new items (Chin, 1998b). When the items related to each construct is finalized, another iteration of factor analysis is conducted and the results are compared with the acceptable suggested value (above 0.7 of the Cronbach's alpha) recommended for studies in social science disciplines (Allen & Yen, 1981).

### **3.6.3 Structural Equation Modeling Analysis of Theoretical Model**

Structural Equation Modeling (SEM) is used to study relationships among multiple outcomes involving latent variables (Jöreskog, Sörbom, & Magidson, 1979). Component-based SEM approach is adopted through SmartPLS for path modeling with latent variables (LVP).

SEM is called to a large number of statistical models used to evaluate the validity of substantive theories with empirical data (Lei, Wu, & Pennsylvania, 2007). It aims to examine complex relationships among hypothetical or unobserved variables (Wothke, 2010). This approach is appropriate for testing and developing theories of exploratory and confirmatory analyses (Kline, 2005).

SEM is a second-generation data analysis approach which tests the validities of statistical conclusions (Rigdon, 1998; Gefen et al., 2000). Unlike first generation of data analysis tools, it enables users to evaluate measurement models.

Using both structural and measurement models makes SEM a precise analysis technique (Chin, 1998). The analysis in this study is conducted by Partial Least Square (PLS), a variance-based SEM analytical method (Kaplan & Haenlein, 2010).

### 3.6.3.1 Evaluation of Measurement Model Reliability and Validity

Based on the global criteria, several tests have been used to ensure the validity, reliability and accuracy of measurement in the model. Table 15 illustrates these techniques and explains their application in this study.

Table 15: Evaluation of Measurement Model Reliability and Validity

| Purpose of Evaluation | Test Criteria                                                               | Heuristics Applied                                                                                                                                                               | Explanation                                                                                                                                                                                                                                      |
|-----------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Item Reliability      | Item Loadings on Target Construct                                           | - Item Loadings of 0.70 or higher are recommended;<br>- 0.60 for exploratory models or new measurement scales is acceptable (Chin, 1998; Nunnally, 1978).                        | - Item Loadings on their target constructs represent the strength of substantive association between items and their constructs                                                                                                                  |
| Convergent Validity   | Communality Index or Average Variance Extracted (AVE) for a Construct       | - Value should be greater than 0.50 (Chin, 1998b, Fornell & Larcker, 1981)                                                                                                       | - Communality Index or AVE represents a measure of the proportion of variance captured by a construct from its indicators.<br>- AVE of 0.50 or higher implies that a latent construct can account for at least 50 % of the variance in the item. |
|                       | Composite Reliability                                                       | - Value should be greater than 0.60 (Bagozzi & Yi, 1988); or 0.70 according to some researchers (Fornell & Larcker, 1981)                                                        | - It is a measure of internal consistency reliability of a construct as compared with other constructs in the model.                                                                                                                             |
|                       | Cronbach's alpha                                                            | - Value should exceed 0.70 (Cronbach, 1951; Nunnally, 1978; Chin, 1998b, Gefen et al., 2000b)                                                                                    | - It also measures the internal consistency reliability of a construct on a single basis, i.e. it is not a relative index like composite reliability.                                                                                            |
| Discriminant Validity | Inter-Correlation among constructs cross-tabulated with square roots of AVE | - The square root of the AVE should exceed the inter-correlations of a construct with other constructs in the model (Fornell & Larcker, 1981; Chin, 1998b, Gefen et al., 2000b). | - A construct should have discernable as a valid individual component within the overall model.                                                                                                                                                  |
|                       | Item Cross-Loadings                                                         | - Item Correlations with Target Construct should be higher compared to its correlations with other constructs in the model (Chin, 1998b).                                        | - Indicators that are meant to measure their target construct should be more strongly associated with them as compared to other constructs in the model.                                                                                         |

### 3.6.3.2 Evaluation of the Structural Model

In order to assess the significance of relationships in the structural model, a round of bootstrapping is conducted. Using the re-sampling technique with 200 replications provides a more conservative testing of the parameters (Fornell & Barclay, 1983; Chin, 2001). Table 16 shows the different evaluation techniques applied to the assessment.

Table 16: Evaluation of Measurement Model Reliability and Validity

| Purpose of Evaluation                     | Test Criteria                                                                                                                                                       | Heuristics Applied                                                                                                                                                                                                                                                                                            | Explanation                                                                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nomological Validity<br>(Construct Level) | - Model Fit/<br>Predictability: Variance<br>Explained ( $R^2$ ) for all<br>constructs in the<br>model.<br><br>- Average Predictability<br>of entire model ( $R^2$ ) | - No specific heuristics available.<br>Value needs to be interpreted in<br>comparison to similar studies or<br>norm in the discipline (Gefen et<br>al., 2000b).<br>- Falk et al. (1992)<br>recommended minimum value<br>of 0.10 for a construct to be<br>considered viable within the<br>nomological network. | - $R^2$ value for endogenous variable<br>represents the proportion of its<br>variance that can be explained by<br>the predictors in the model.<br><br>- Average $R^2$ allows comparison<br>across competing models. |
|                                           | - Path Validity<br>Coefficients;<br>Significance (p-values)                                                                                                         | - Inner model paths should be<br>significant at $<0.05$ level to<br>provide support for proposition<br>in the theoretical model.                                                                                                                                                                              | - A significant path represents the<br>an association between two latent<br>variables was not a chance<br>happening.                                                                                                |
|                                           | -Predictability Effect<br>Size: Effect Size ( $f^2$ ) for<br>criterion variables<br>based on the exclusion<br>of a predictor variable<br>from the model             | - Predictor variable should<br>ideally have a large or medium<br>effect.<br>- The following scheme can be<br>used to determine effect sizes:<br>Small Effect: 0.02; Medium<br>Effect: 0.15; Large Effect: 0.35<br>(Chin, 1998b).                                                                              | - $f^2$ value between a predictor and a<br>criterion variable represents the<br>effect of the predictor on the<br>criterion variable. Higher values<br>imply that greater importance                                |
| Goodness of Fit                           | - Global Criterion of<br>goodness-of fit (GoF)                                                                                                                      | - The following baseline values<br>can be used to evaluate the<br>overall model fit: Low fit: 0.1;<br>Medium fit: 0.25; High fit: 0.36<br>(Tenenhaus et al., 2005; Wetzels<br>et al., 2009).                                                                                                                  | - GoF values allow a scalar based<br>assessment (summative index) of<br>the model as whole.<br>- GoF values allow comparisons<br>across competing models.                                                           |

### 3.7 Restructuring the Theoretical Model

During our analysis we found that responses to the items related to “Information Accessibility” and “Perceived Ease of Use” were in a similar fashion. Therefore, we decided to combine these two constructs into a single construct called “Usability and Accessibility” and perform the analysis. It should be noted that in this study, the term “Usability” is not being used in the strictest and broadest sense. The term has been adopted as such for the sake of simplifying, and as such our conceptualization is similar to that of the original “Ease of Use” construct. After implementing these changes, the new model is presented in Figure 6.

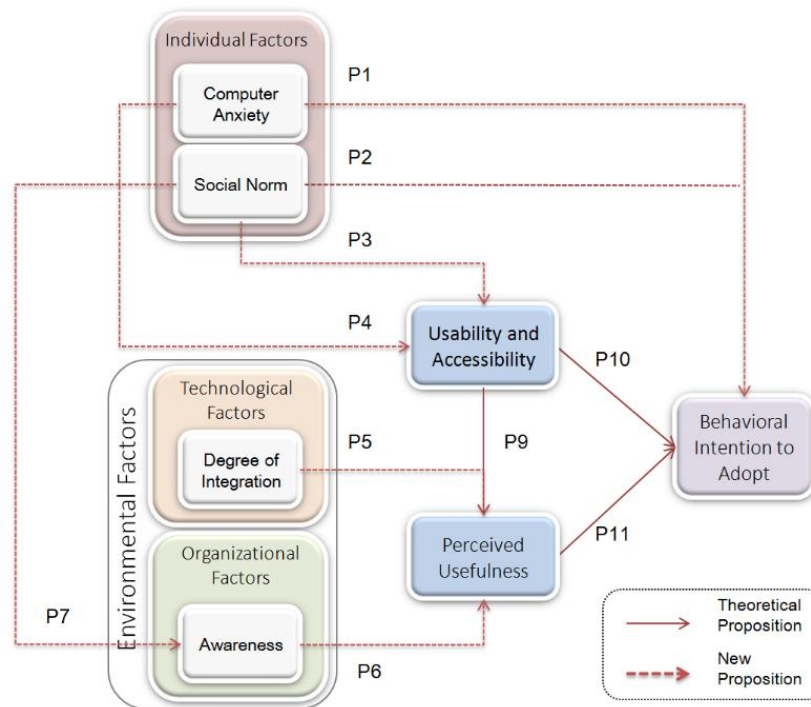


Figure 6: The Refined Theoretical Model

As a result, P4 is changed as shown in the Table 17 and P8 is eliminated.

Table 17: Path Propositions and validations (Modified Paths)

| Proposition | New Model Path                                                                                             |
|-------------|------------------------------------------------------------------------------------------------------------|
| P4          | Lower Computer Anxiety among PHRs users corresponds with higher Usability and Accessibility of Using PHRs. |

The following chapter includes analyzes and interpretations according to our new model.

## 4.0 Data Analysis and Results

This chapter represents the key findings of the conducted survey for this study. These findings include demographic and technographic aspects of the research and is followed by the analysis of psychographic results using the SEM.

### 4.1 Participant Characteristics and Descriptive Statistics

The respondents were under no obligation for filling out the survey questions. Hence, some of the obtained data records are incomplete and are not use for the analysis. During the data cleansing, incomplete and low quality records were removed from the data file. Out of 200 collected responses in the survey, 130 were considered as useful for the analytical procedures.

#### Demographic and Technographic Questions

The following figures illustrate the demographic properties of the surveyed sample and also the frequencies of the important metrics that could affect the adoption of PHRs. 54% of the Participants in the survey were male and 46% were female and only 5% of the respondents were PHRs users.

As shown in the figure 7 and 8, majority of the respondents were neither caregiver nor patient. More than one third (37%) of the sample population are actually in the process of dealing with a health issue. Moreover, More than 80% of the respondents have seen at least one physician in the past six months which represents a relatively high frequency of interacting with the health professionals.

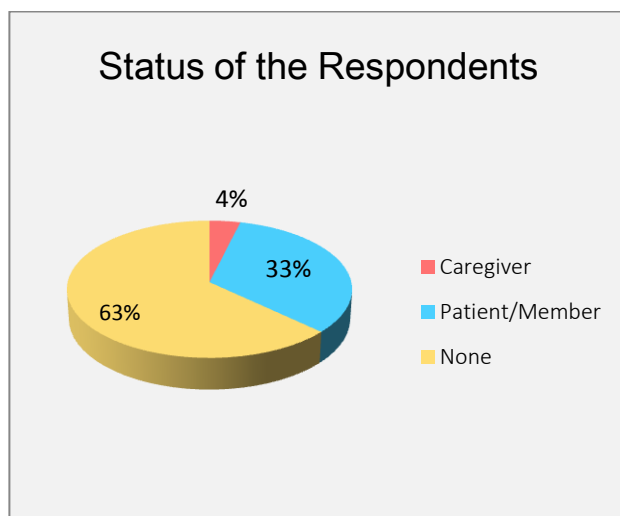


Figure 7: Status of the Respondents

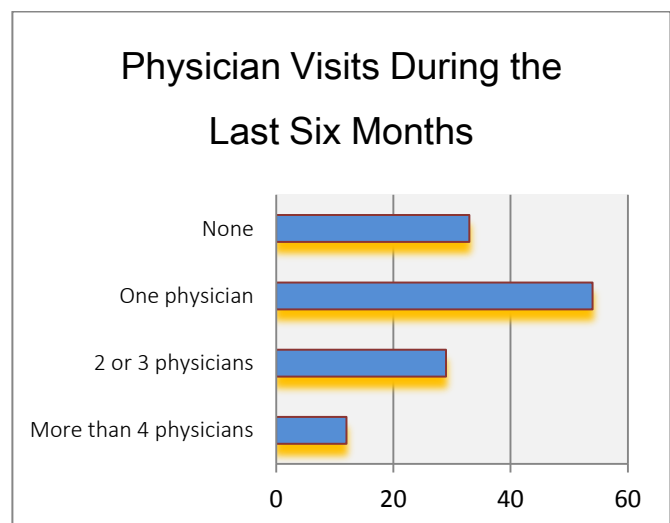


Figure 8: Physician Visits during the Last Six Months

“Access to the healthcare when necessary”, was the most important identified health issue among the participants. It is followed by “reducing the care costs” and “understanding the health condition” as the other major health problems for our target audience. The least important among the provided options was identified as “being able to manage my regimen effectively”. Figure 9 illustrated the percentage of using different means of maintaining health records among the individuals. Interestingly, almost half of the respondents still maintain their health records on paper. 28% use the Website platforms and only 9% access their records through mobile devices.

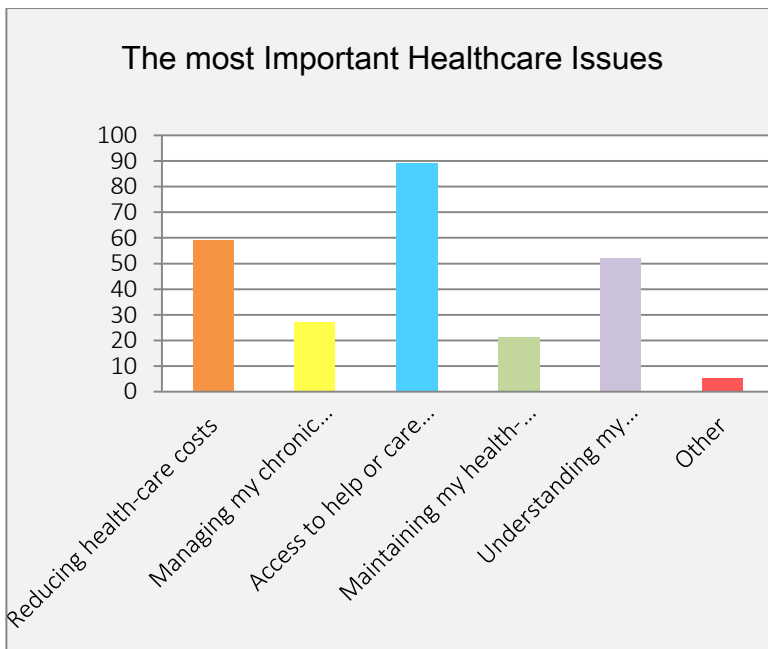


Figure 10: The Most Important Healthcare Issues

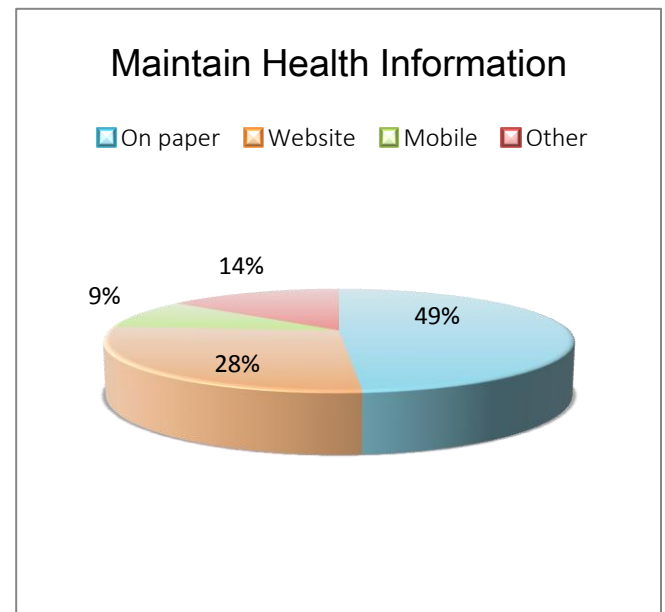


Figure 9: Maintain Health Information

In the survey, respondents were asked to determine how much certain use cases were applicable to their health condition. Figure 11 and Figure 12 illustrates the responses to the five identified use cases and the degrees that each case was associated with our sample.

As the figures show, chronic illness is the most applicable scenario to the sample population indicating the average 3.30 in the scale of 1-5 when 1 represents the least degree of applicability and 5 represents the most degree of applicability. It is followed by “managing health diary” and “inherited disease prevention” as the most important scenarios applicable to the majority of the participants.

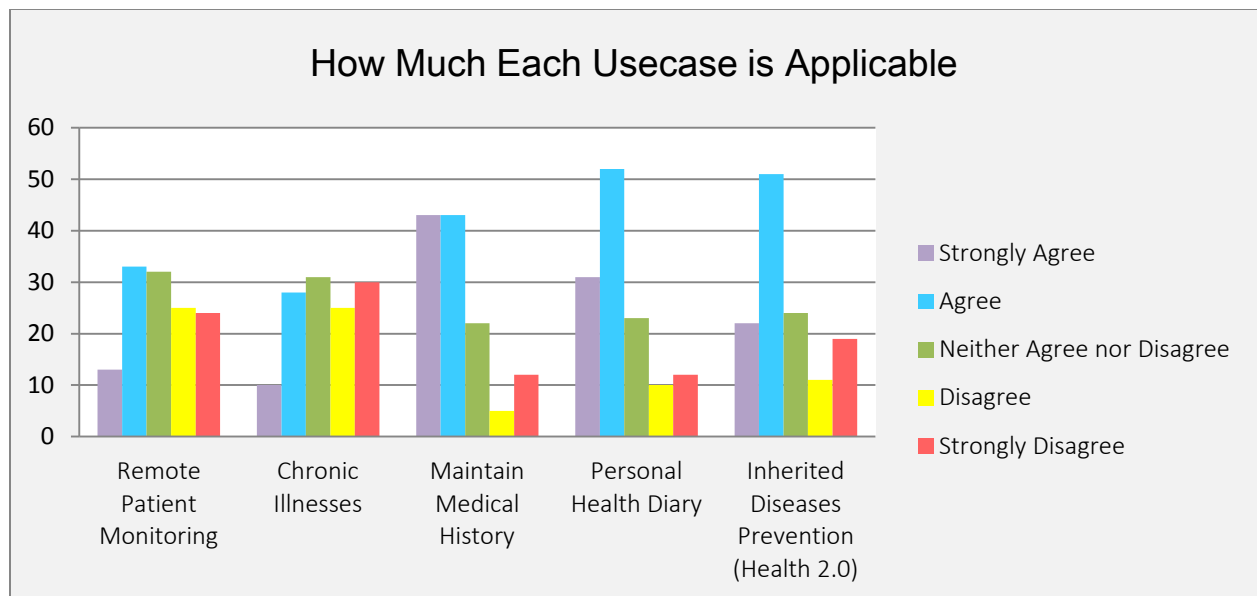


Figure 11: How Much Each Usecase is Applicable

The minor scenario applicable in the survey is “maintaining medical history” with the average 2.20 in the scale of 1-5 when 1 represents the lowest degree of applicability and 5 represents the highest degree of applicability.

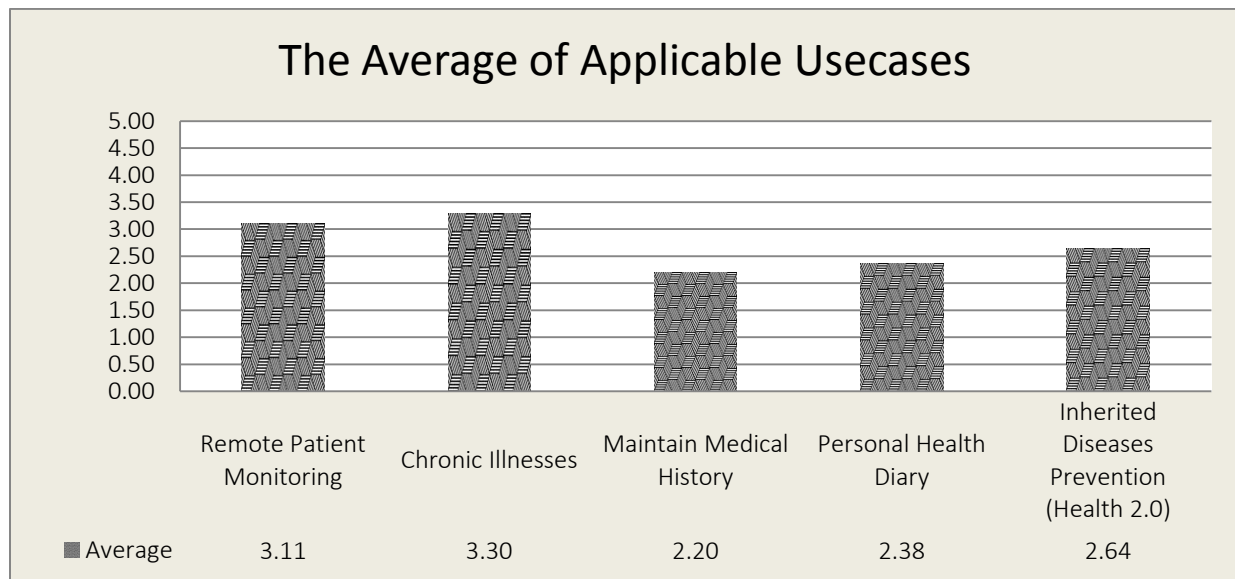


Figure 12: Usecase Applicability

## **4.2 Research Proposed Structural Model Validation**

In order to validate the research model construct items and ensure about the reliability of analysis, one should measure a construct through its associated items (Straub, Boudreau et al, 2004) using techniques such as Cronbach's alpha and correlations.

## **4.3 Structural Equation Modeling Analysis**

The SEM analysis conducted in this study has two main steps. In the first step, the measurement model will be evaluated through the assessment of the key measurements. The analysis is then followed by validating the model by assessing the relationships among the constructs.

### **4.3.1 Evaluation of the Measurement Model**

The validities of the constructs are tested by measuring the Discriminant and Convergent validities. Discriminant validity aims to validate whether the items reflecting a construct are better than other items associated with that construct. Convergent validity is obtained when the items reflect excellent correlations with their associated constructs and high correlation with all other constructs (Straub, Boudreau et al, 2004). The matrix of loadings and cross-loadings of the model are presented in Table 18. It shows high degree of significance for each item (average loading greater than 0.7 for each construct) on its respective construct.

Table 18: Matrix of Loading and Cross Loadings

| Measurement Items | Model Construct |              |              |              |              |              |              |
|-------------------|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                   | IA & PEOU       | AW           | BI           | CAX          | DI           | PU           | SN           |
| Q1.1              | -0.069          | 0.128        | -0.142       | <b>0.720</b> | -0.017       | -0.090       | 0.056        |
| Q1.2              | 0.026           | 0.087        | -0.226       | <b>0.891</b> | 0.032        | -0.165       | 0.039        |
| Q1.3              | 0.104           | 0.198        | -0.097       | <b>0.654</b> | 0.200        | -0.049       | 0.122        |
| Q2.1              | 0.356           | 0.246        | <b>0.753</b> | -0.301       | 0.382        | 0.662        | 0.479        |
| Q2.2              | 0.595           | 0.456        | <b>0.793</b> | -0.039       | 0.501        | 0.607        | 0.450        |
| Q2.3              | 0.546           | 0.322        | <b>0.804</b> | -0.173       | 0.439        | 0.455        | 0.485        |
| Q3.1              | 0.585           | <b>0.856</b> | 0.365        | 0.084        | 0.475        | 0.522        | 0.504        |
| Q3.2              | 0.568           | <b>0.851</b> | 0.407        | 0.136        | 0.359        | 0.473        | 0.553        |
| Q3.3              | 0.560           | <b>0.728</b> | 0.279        | 0.183        | 0.399        | 0.244        | 0.466        |
| Q4.1              | 0.369           | 0.304        | 0.609        | -0.253       | 0.331        | <b>0.821</b> | 0.348        |
| Q4.2              | 0.446           | 0.548        | 0.630        | -0.017       | 0.434        | <b>0.861</b> | 0.527        |
| Q4.3              | 0.383           | 0.430        | 0.599        | -0.120       | 0.359        | <b>0.797</b> | 0.387        |
| Q5.1              | 0.533           | 0.472        | 0.565        | -0.071       | 0.400        | 0.578        | <b>0.729</b> |
| Q5.2              | 0.456           | 0.515        | 0.242        | 0.308        | 0.431        | 0.153        | <b>0.746</b> |
| Q5.3              | 0.535           | 0.426        | 0.504        | -0.009       | 0.456        | 0.375        | <b>0.776</b> |
| Q6.1              | <b>0.724</b>    | 0.572        | 0.391        | 0.058        | 0.343        | 0.360        | 0.554        |
| Q6.2              | <b>0.657</b>    | 0.418        | 0.374        | 0.091        | 0.441        | 0.242        | 0.344        |
| Q6.3              | <b>0.774</b>    | 0.566        | 0.485        | -0.031       | 0.467        | 0.307        | 0.547        |
| Q7.1              | 0.410           | 0.409        | 0.353        | 0.081        | <b>0.823</b> | 0.422        | 0.388        |
| Q7.2              | 0.557           | 0.374        | 0.486        | 0.032        | <b>0.811</b> | 0.320        | 0.446        |
| Q7.3              | 0.566           | 0.404        | 0.525        | 0.047        | <b>0.730</b> | 0.322        | 0.541        |
| Q8.1              | <b>0.773</b>    | 0.620        | 0.466        | 0.065        | 0.583        | 0.438        | 0.557        |
| Q8.2              | <b>0.864</b>    | 0.521        | 0.563        | -0.003       | 0.565        | 0.409        | 0.516        |
| Q8.3              | <b>0.828</b>    | 0.528        | 0.617        | -0.048       | 0.523        | 0.449        | 0.600        |

#### 4.3.1.1 Measurement Model Assessment: Discriminant Validity at Item level

Since the loading for all items exceeds the threshold of 0.7, suggested by Nunnally (1978) and Chin (1998), and also the items have even higher loadings with the associated constructs, the measurement model is considered as reliable at the item level and eventually the discriminant Validity of the model is obtained.

#### 4.3.1.2 Measurement Model Assessment: Discriminant Validity at Construct level

At construct level, discriminant Validity is assessed by evaluating correlation among latent variables. In order to do so, the square root of Average Variance Extracted (AVE) was compared with the calculated correlations. Table 19 illustrates the latent variable correlations. The table shows that the square root values are higher than the correlation values in the same row and column. Therefore, according to Fornell and Larcker (1981); Chin (1998); Gefen et al. (2000), the discriminant validity of the model is verified.

Table 19: Average Variance Extracted and Inter-Construct Correlations

| Measurement Items             | Model Construct |              |              |              |              |              |              |
|-------------------------------|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                               | IA &            | AW           | BI           | CAX          | DI           | PU           | SN           |
| Accessibilty & Usability      | <b>0.773</b>    |              |              |              |              |              |              |
| Awareness                     | 0.697           | <b>0.814</b> |              |              |              |              |              |
| Behavioral Intention to Adopt | 0.635           | 0.436        | <b>0.784</b> |              |              |              |              |
| Computer Anxiety              | 0.020           | 0.157        | -0.219       | <b>0.762</b> |              |              |              |
| Degree of Integration         | 0.634           | 0.502        | 0.563        | 0.071        | <b>0.789</b> |              |              |
| Perceived Usefulness          | 0.485           | 0.525        | 0.741        | -0.149       | 0.457        | <b>0.827</b> |              |
| Social Norm                   | 0.682           | 0.624        | 0.602        | 0.079        | 0.571        | 0.515        | <b>0.750</b> |

#### 4.3.1.3 Measurement Model: Convergent Validity

The convergent validity of the model is assessed through investigating the Cronbach's alpha, the AVE and the Composite Reliability obtained from the analysis.

The assessment of Cronbach's alpha shows that all of the constructs have sufficient internal consistency within the model which adds validity to the interpretation of constructs (Cronbach, 1951; Nunnally, 1978; Chin, 1998, Gefen et al, 2000). All constructs have AVE above 0.5 which demonstrate convergent validity and ensure that constructs are reliable and reflective in our model (Fornell & Larcker 1981; Chin, 1998). Also, the Composite Reliability of every construct in the model ensure the reliability of our data and having robust measures as it exceeds the purposed rate of 0.7 (Nunnally, 1978).

Table 20: Constructs Statistics – Convergent Validity

| Construct                     | AVE   | Composite Reliability | Cronbach's alpha |
|-------------------------------|-------|-----------------------|------------------|
| Accessibilty & Usability      | 0.597 | 0.898                 | 0.864            |
| Awareness                     | 0.662 | 0.854                 | 0.746            |
| Behavioral Intention to Adopt | 0.614 | 0.827                 | 0.686            |
| Computer Anxiety              | 0.580 | 0.803                 | 0.652            |
| Degree of Integration         | 0.622 | 0.831                 | 0.699            |
| Perceived Usefulness          | 0.683 | 0.866                 | 0.768            |
| Social Norm                   | 0.563 | 0.794                 | 0.615            |

#### 4.3.1.4 Predictability and Coefficients of Determination of Model Constructs

The assessment Predictability and Coefficients of Determination ( $R^2$ ) in the model explains the variance of the construct that can be predicted by the antecedent constructs. In some studies the  $R^2$  greater than 0.1 validates the usefulness of the endogenous construct in a model (Falk & Miller, 1992). The Coefficients of Determination ( $R^2$ ) associated with the constructs is presented in Table 21.

Table 21: Constructs Coefficients of Determination ( $R^2$ )

| Latent Variable               | R Square       |
|-------------------------------|----------------|
| Accessibilty & Usability      | <b>0.466</b>   |
| Awareness                     | <b>0.390</b>   |
| Behavioral Intention to Adopt | <b>0.682</b>   |
| Computer Anxiety              | na (exogenous) |
| Degree of Integration         | na (exogenous) |
| Perceived Usefulness          | <b>0.331</b>   |
| Social Norm                   | na (exogenous) |

The table shows that Coefficients of Determination related to the three endogenous construct exceeds the recommended threshold. A&U, AW, BI and PU have an acceptable value of the  $R^2$  and are proved to have strong correlations with their connected constructs.

#### 4.3.1.5 Path Validity Coefficient in the Structural Model

In this section, Path validity coefficient in the model is examined. For this purpose, the software is run in the bootstrapping mode. The value of t-stat is used for determining the significance level associated with each path. Figure 13 represents the decision making process on the approval or rejection of each hypotheses.

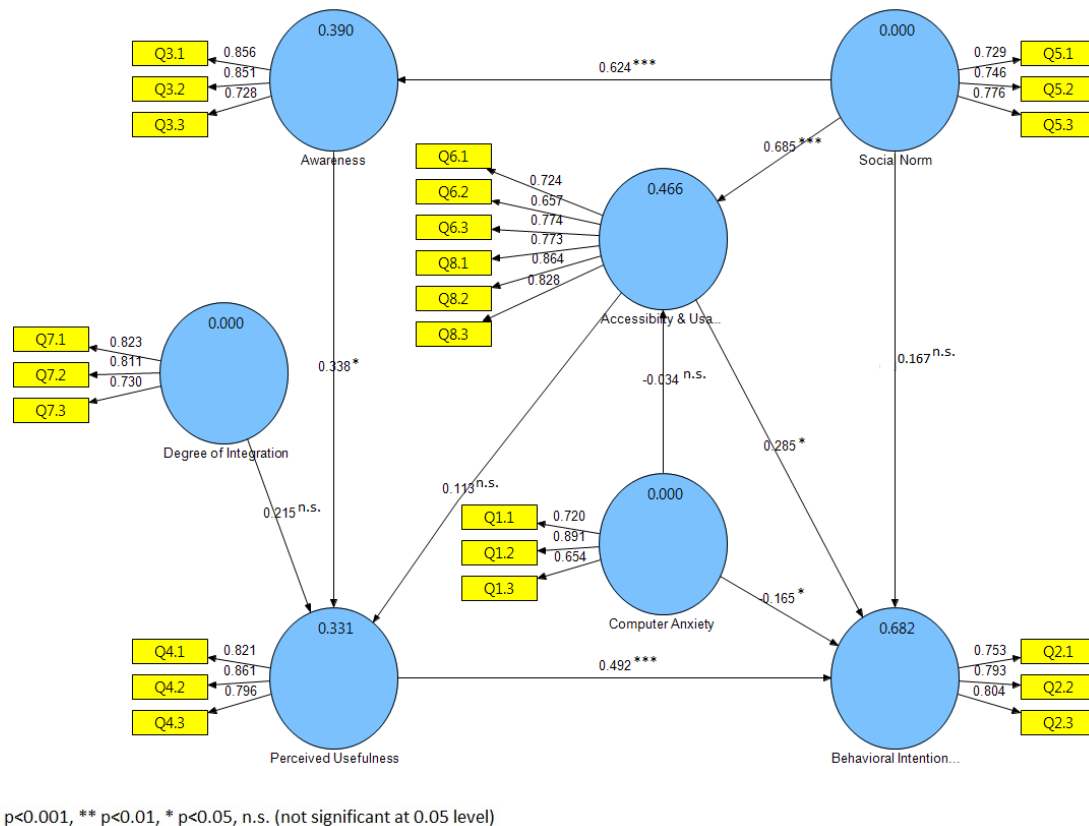


Figure 13: The Structural Model

Table 22 shows the parameters obtained by a round of “Bootstrapping” in SmartPLS with 200 re-samples. The evaluation of path coefficient reliability measures shows that results of the structural model are reliable. Low rate of standard error indicate high reliability of the sample mean which represents more accurate reflection of the actual population. Considering the P-Value lower than the alpha level (0.05) most of the paths in the model display significant relationship.

Table 22: Combined Data Path Validity Analysis

| Hypotheses<br>(Model Paths)                                | Betas<br>(Path Coefficients) | T Statistics | P Values | Significance<br>Levels | Validation |
|------------------------------------------------------------|------------------------------|--------------|----------|------------------------|------------|
| Accessibility & Usability -> Behavioral Intention to Adopt | 0.285                        | 2.493        | 0.014    | < 0.05                 | Supported  |
| Accessibility & Usability -> Perceived Usefulness          | 0.113                        | 0.660        | 0.510    | n.s.                   | Rejected   |
| Awareness -> Perceived Usefulness                          | 0.338                        | 2.521        | 0.013    | < 0.05                 | Supported  |
| Computer Anxiety -> Accessibility & Usability              | -0.034                       | 0.343        | 0.732    | n.s.                   | Rejected   |
| Computer Anxiety -> Behavioral Intention to Adopt          | -0.165                       | 2.166        | 0.032    | < 0.05                 | Supported  |
| Degree of Integration -> Perceived Usefulness              | 0.215                        | 1.766        | 0.080    | n.s.                   | Rejected   |
| Perceived Usefulness -> Behavioral Intention to Adopt      | 0.492                        | 5.250        | 0.000    | < 0.001                | Supported  |
| Social Norm -> Accessibility & Usability                   | 0.685                        | 10.393       | 0.000    | < 0.001                | Supported  |
| Social Norm -> Awareness                                   | 0.624                        | 8.764        | 0.000    | < 0.001                | Supported  |
| Social Norm -> Behavioral Intention to Adopt               | 0.167                        | 1.974        | 0.051    | n.s.                   | Rejected   |

#### 4.3.1.6 Predictability Effect Sizes in the Estimated Structural Model

Predictability effect sizes of the model determine the predictive power of antecedent constructs on their consequents (Chin, 1998b). It was done by comparing  $R^2$  value of the dependent construct to its consequent construct using the following formula.

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

Table 23: Effect Sizes for the Estimated Structural Model

| Consequent | AW             |                | BI             |                | CAX            |                | DI             |                | IA & U         |                | PU             |                | SN             |                |
|------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Antecedent | R2<br>Included | R2<br>Excluded | R2<br>Included | R2<br>Excluded | R2<br>Included | R2<br>Excluded | R2<br>Included | R2<br>Excluded | R2<br>Included | R2<br>Excluded | R2<br>Included | R2<br>Excluded | R2<br>Included | R2<br>Excluded |
| AW         |                |                |                |                |                |                |                |                |                |                | 0.331          | 0.39           |                |                |
| BI         |                |                |                |                |                |                |                |                |                |                | -0.088         |                |                |                |
| CAX        |                |                | 0.682          | 0              |                |                |                |                | 0.466          | 0              |                |                |                |                |
| DI         |                |                | 2.145          |                |                |                |                |                | 0.873          |                |                |                |                |                |
| IA & U     |                |                |                |                |                |                |                |                |                |                | 0.331          | 0              |                |                |
| PU         |                |                |                |                |                |                |                |                |                |                | 0.495          |                |                |                |
| SN         |                |                | 0.682          | 0.466          |                |                |                |                |                |                | 0.331          | 0.466          |                |                |
|            |                |                | 0.679          |                |                |                |                |                |                |                | -0.202         |                |                |                |
|            |                |                | 0.682          | 0.331          |                |                |                |                |                |                |                |                |                |                |
|            |                |                | 1.104          |                |                |                |                |                |                |                |                |                |                |                |
|            | 0.39           | 0              | 0.682          | 0.000          |                |                |                |                | 0.466          | 0.000          |                |                |                |                |
|            | 0.639          |                | 2.145          |                |                |                |                |                | 0.873          |                |                |                |                |                |

According to (Cohen, 1988), the values of  $R^2$  below 0.02 considered small, 0.15 is medium and 0.35 has large effect on the model. The value of predictability effect sizes of the model are presented in Table 23 and the predictability level of each construct are summarized in Table 24.

Table 24: Effect Sizes for the Estimated Structural Model Results

| Consequent<br>Antecedent | AW    | BI    | CAX | DI | IA & U | PU    | SN |
|--------------------------|-------|-------|-----|----|--------|-------|----|
| AW                       |       |       |     |    |        | Small |    |
| BI                       |       |       |     |    |        |       |    |
| CAX                      |       | Large |     |    | Large  |       |    |
| DI                       |       |       |     |    |        | Large |    |
| IA & U                   |       | Large |     |    |        | Small |    |
| PU                       |       | Large |     |    |        |       |    |
| SN                       | Large | Large |     |    | Large  |       |    |

#### 4.3.1.7 Global Goodness of Fit

To fill the lack of a global validation of the component-based models (Tenenhaus et al., 2005) many researchers have consulted the global criterion of goodness-of-fit ( $0 \leq \text{GoF} \leq 1$ ) (Amato et al., 2004; Tenenhaus et al., 2005). This test is defined as the geometric mean of the average communality (same value of the AVE in PLS) and the average of the  $R^2$  (for endogenous constructs) (Tenenhaus et al., 2005; Wetzels et al., 2009).

The average communality should be calculated as a “weighted average” of communality (AVE) considering the number of items in each construct as its weight (Tenenhaus et al., 2005). Then the following formula is used to present the geometric mean of the average communality and the average  $R^2$ .

$$\text{GoF} = \sqrt{\overline{AVE} \times \overline{R^2}}$$

$\overline{AVE}$  and the  $\overline{R^2}$  are the weighted average of AVE and average  $R^2$  respectively.

There are no specifications of heuristics for the GoF index by the original authors; however, some articles have inferred the heuristics for AVE and  $R^2$  in order to reach a standard criterion for GoF (e.g. Wetzels et al., 2009). Since in the previous sections of validations, the proposed cut-off value of 0.5 for AVE is used (Fornell and Larker, 1981) and effect sizes for  $R^2$  the proposed values by (Cohen, 1988), i.e. small; 0.02, medium; 0.13, large; 0.26, the criteria of the GoF can be reached for small, medium, and large effect sizes of  $R^2$  through substituting the

minimum average AVE of 0.50 and the effect sizes for  $R^2$  in the previous equation. That results in the following baseline values for GoF: GoF small= 0.1; GoF medium = 0.25; and GoF large = 0.36 (Wetzels et al., 2009). After calculating the GoF for a structural model it will be compared to the baseline values to infer the goodness of fit of a model.

**Table 25: Calculation of the Global Criterion for Goodness-of-Fit (GoF)**

| Model Construct               | Communality (Ave) | Variance Explained (R <sup>2</sup> ) | Number of Indicators |
|-------------------------------|-------------------|--------------------------------------|----------------------|
| Behavioral Intention to Adopt | 0.614             | 0.684                                | 3                    |
| Computer Anxiety              | 0.583             | 0.003                                | 3                    |
| Usability and Accessibility   | 0.743             | 0.427                                | 6                    |
| Perceived Usefulness          | 0.683             | 0.356                                | 3                    |
| Average R-Square              | 0.656             | 0.3675                               |                      |
| Goodness of Fit Index         |                   | 0.491                                |                      |

According to the calculation of the index presented in the Table 25, the value of GoF for the model exceeds the large effect sizes value of  $R^2$  of 0.35.

#### 4.4 Open Ended Question

In the customers' point of view, security and privacy was found as a crucial point of concern in determining their behavior towards using PHRs. The cost of receiving health management services does not seem to be a barrier for majority of the respondents.

**Table 26: Important Factors to Determine the User Behavior**

| Area        | Factor                                              | Responses |
|-------------|-----------------------------------------------------|-----------|
| Usefulness  | Up to date, accurate and comprehensible information | 8         |
|             | Control                                             | 2         |
|             | Availability                                        | 11        |
|             | Integration and data import capabilities            | 9         |
|             | Provide benefits                                    | 4         |
|             | Sum                                                 | 34        |
| Ease of use | Easy use and management                             | 10        |
|             | User friendly                                       | 2         |
|             | Training                                            | 1         |
|             | Sum                                                 | 13        |
| Other       | Low cost (free)                                     | 4         |
|             | Security and privacy                                | 22        |
|             | Sum                                                 | 26        |
| Total       |                                                     | 73        |

Among the other specified factors, those associated with PHRs usefulness (good information, integration and control, availability e.g.) is mentioned almost triple times more than those related to the system's ease of use (easy to use and user friendliness e.g.). One respondent highlighted that "Interconnectability between my PHR and the EMR used by my PCP and my cardiologist, both are part of the same hospital/doctor system, But use 2 different systems. Only the PCP EMR has a patient portal and neither talks to MS Health Vault". Another respondent focused on the system integration and mentioned "Being able to communicate with my doctor's regarding my chronic health issues and he actually seeing and responding to my concerns and questions".

Some comments were raising the importance of the system Usability. It was mentioned by a respondent that "I'm referring to a mobile device application that would allow me to simply update relevant health information in mere seconds. This information is then synced with personal/private health records across schools, insurance companies, work, and hospitals. An idea like this in this era is worth paying for".

The role of physicians in the acceptance of PHRs which was discussed in the chapter2 is emphasized by another respondent that "if Dr. had it as a communication tool, I would be encouraged to use it".

Therefore, it could be assumed that PHRs value among the users have greater emphasize in its functionalities that could assess individuals' health condition and is less focused on the system usefulness.

## 5.0 Discussion and Conclusion

Previous chapter described the quantitative analysis of the collected data. This chapter demonstrates the main highlights about the answers to our research questions and will be followed by the contribution of the study along with its limitations and future directions. In the last part of this chapter, a conclusion from all the effort is provided.

The objective of this research is to identify the individual and environmental factors that influence the end-user adoption of patient facing Information systems (PFIS) such as PHRs. Toward this, the following sections are discussing the three layers' constructs and their impacts on users' behavior regarding PHRs.

### 5.1 Structural Model Validity

An overview of the structural model and its path coefficients are presented in the Figure 14. The significance of the relationships is discussed for all the layers forming the empirical model including individual layer, environmental layer (technical and organizational factors) and technology acceptance layer.

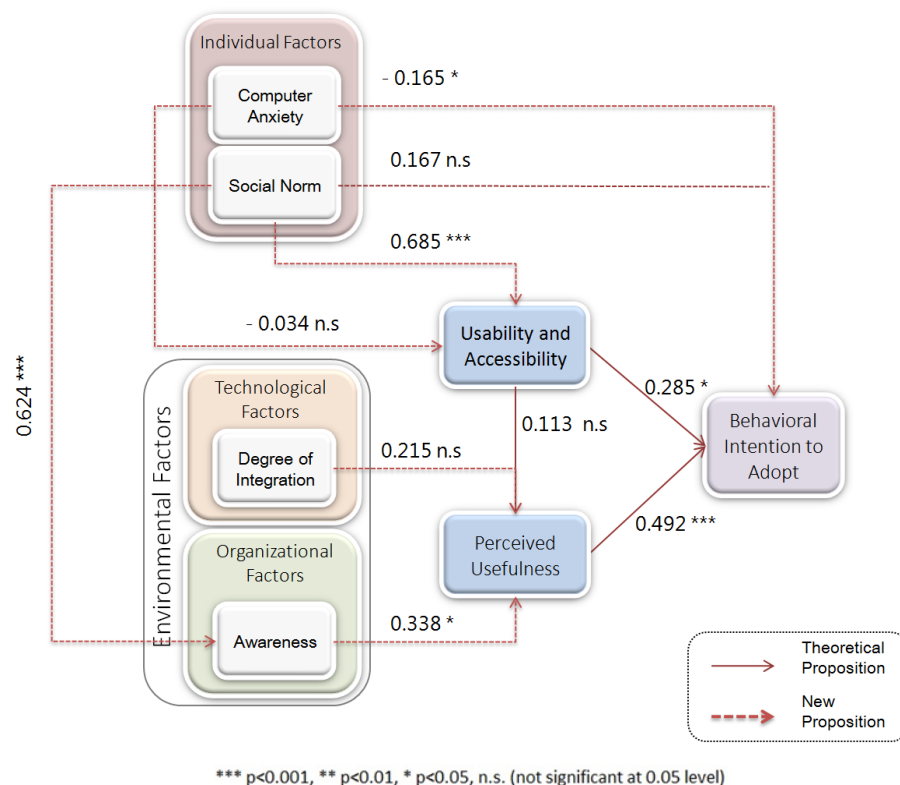


Figure 14: Structural model validity

### 5.1.1 Individual Layer

Research by Tolba, (2011) has identified the Individual characteristics affecting the diffusion of IT innovation. HIT systems acceptance carry a different role among their users due to the sensitive nature of the health information that should be managed by the system and the important role of the system performance in the health decision making.

It is evident from the result of our analyzed data that most of the individual factors are correlated with the usage of PHRs. Three out of five defined propositions made in the individual level are supported. In the following, the obtained results will be compared with the previous studies and the justification behind them will be explained.

#### Computer Anxiety and Intention to use

Computer anxiety has been identified as a major obstacle in the adoption of personal health information systems according to many studies. Stated by Thatcher & Perrew (2002), “Individuals who feel anxious or uncomfortable about using computers or technology are less likely to adopt technology”. Some other studies such as Igbaria & Chakrabarti (1990) have shown the reverse effects of Computer Anxiety on the users’ acceptance behavior. This behavioral difference will affect the ability of the person in using the information system. For example, the study by (Lober et al., 2006) shows that the majority of the individuals with high level of computer anxiety could not independently manage their health records.

Similarly, this study found that the computer anxiety is a significant predictor in users’ acceptance of PHRs. The result of analysis confirms the correlation of these constructs in this study too. Hence, lower level of users’ anxiety is expected to increase their intention to use the system. Table 27 presents the individual factors’ defined paths, their coefficient and their validation results.

Table 27: Path1 Propositions and Validations (Individual Factors)

| Proposition | Model Path                                                                                            | Path Coefficients | Validation |
|-------------|-------------------------------------------------------------------------------------------------------|-------------------|------------|
| P1          | Lower level of Computer Anxiety among PHRs users corresponds with higher Intention to use the system. | -0.165 (Sig)      | Supported  |

The correlation could be justified with the fact that an individual’s unfamiliarity with the computer makes him worried that he might appear clumsy in front of others or worried that his ignorance may cause damage to the computer (Chuo, Tsai, Lan, & Tsai, 2011).

It also should be noted that users of Personal health systems not only have the computer anxiety related to an information system, but the sensitivity of the health records and their perceived high risk of misaccuracy and making mistakes.

As indicated in our literature review, the higher willingness of the chronic patients in participation in their health management and their higher level of risk acceptance. Since our participants were more consumers than being patients, they could be more careful and cautious.

### **Social Norms and Intention to Use**

The effect of social norms on the users' perceived usefulness of the system in CHI was previously tested and validated in many studies in the context of theories of planned behavior (Taylor, Bury, & Campling, 2006), theory of reasoned action (Baker, Morrison, Carter, & Verdon, 1996) and TAM 2 (Yu, Li, & Gagnon, 2009; Kowalczyk, 2012). However, the existence of a direct positive relationship between the two construct has not been fully explored. The original TAM consciously excluded constructs relating to social norms due to concerns about the strength of the psychometric scales used and the highly individual nature of the personal computing programs under study (Davis et al., 1989). It is likely that this could be the reason for the existing literature gap about the relationship of Social Norms of PHRs among the users with their intention to use.

The result of analysis confirms the weak correlation of the two constructs in this study too meaning that Social Norms of the PHR among the participants is not as important predictor as some other factors explored in this research.

Table 28 presents the individual factors' defined paths, their coefficient and their validation results.

**Table 28: Path2 Propositions and Validations (Individual Factors)**

| Proposition | Model Path                                                                                                | Path Coefficients | Validation |
|-------------|-----------------------------------------------------------------------------------------------------------|-------------------|------------|
| P2          | Higher Social Norms of PHR among the users is associated with higher intention to use the system by them. | 0.167 (ns)        | Rejected   |

It was suggested by Ajzen, (1991) that Social Norms corresponding to PHRs supports the Intention to Use of the system. However, this is not supported in our study. Indeed, in our

model, the Social Norms corresponding to PHRs effects on the Intention of Use in two different ways through domino effect of the factors.

The first way shows raising the level of Social Norms corresponding to PHRs systems conveys the message of Usability and Accessibility to the users. It means that as the popularity of PHRs increases and it becomes a norm in the society, more people perceive PHRs as a usable product and start using the system.

Through the second way, the Social Norms associated to PHRs raises the Awareness in society. When PHRs popularity increases, people become educated and eventually more individuals decide to use the system. It seems that before making the final decision on using PHRs, individuals need to be educated rather than deciding to utilize the system just because other people use it.

### **Social Norms and Usability & Accessibility**

The importance of usability of an information system is discussed in many studies (Bruno & Dick, 2013). Specifically, some studies evaluated the usability in the context of PHRs like (Ant Ozok, Wu, Garrido, Pronovost, & Gurses, 2014). As indicated by Goldberg et al., (2011), progress in providing health information to patients can be accelerated by innovative social networking strategies, more effective search capabilities and improved user-interface design.

The findings are consistent with what has been stated by these studies regarding the impact of Social Norms on the perceived Usability and Accessibility of the system. Table 29 presents the defined paths, its strong coefficient and support obtained in the analysis.

Table 29: Path3 Propositions and Validations

| Proposition | Model Path                                                                                      | Path Coefficients | Validation |
|-------------|-------------------------------------------------------------------------------------------------|-------------------|------------|
| P3          | Higher Social Norms of PHR among the users supports higher Usability and Accessibility of PHRs. | 0.685 (Sig)       | Supported  |

The strong power of Social Norms in perceiving the system usability and accessibility could be the result of in practice observation of system performance and actual benefits to the society health management. A research about the acceptance of the HIT among hospital personnel shows that social influence affects the user behavior (Aggelidis & Chatzoglou, 2009). Also, Wu et al. figured that Social norms have a direct impact on users' behavior in using a reporting

system (Wu et al., 2008). When people see the PHR system in action, they will perceive the system benefits in managing the health condition of their peers and also they feel that the system is understandable and easy to use.

## Social Norms and Awareness

The role of Social Norms associated with the awareness of an information system has been vastly highlighted in the literature. According to (Darnton & Sustainable, 2008) in the study of adoption with the context of the diffusion of innovations theory, the social interaction spreads awareness of the innovation and therefore the adoption behavior is highly rational. As a result, increasing social interaction on personal health systems is expected to educate individuals about the existence and potential values of using it.

The reverse relationship is also validated by the Schwartz's Norm Activation Theory (Schwartz, 1977). According to this theory, individuals pass two steps for the norm activation. In the first step, they become aware of the consequence of their actions. In the second step, they consider the consequences' cost for their decision making. In the same manner, by applying the Norm Activation theory to the PHRs, we can see that individuals initially determine possible consequences of using the system. They perceive the benefits of electronic self-health management, accessing a large source of useful information and communicating with the health professionals. On the other hand, they might also perceive the risks associated with their security and privacy, inaccurate health information or lack of system availability. In the second stage, they calculate their actions' cost (using the system) which could be more effective and efficient health management, better decision making and breaching the security and privacy, paying the subscription fees to PHRs providers and etc. According to the evaluation of the cost associated with the performed action, the decision on the final behavior acceptance or denial will be taken.

Our findings confirm what has been stated in these studies. The assessment of the theoretical model determines that higher Social Norms of PHRs is strongly supported to increase the awareness among the participants. Table 30 presents the defined paths, its strong coefficient and support obtained in the analysis.

Table 30: Path7 Propositions and validations

| Proposition | Model Path                                                                            | Path Coefficients | Validation |
|-------------|---------------------------------------------------------------------------------------|-------------------|------------|
| P7          | Higher Social Norms of PHR among the users supports higher user Awareness about PHRs. | 0.624 (Sig)       | Supported  |

The awareness of PHRs system is found to be raised if using the system could be adopted in the society as a normal health management activity. Like any other Social Norms such as popular Smartphone applications that even non-users have some ideas about them, people will be more aware of PHR if it becomes a norm in the society.

### **Computer Anxiety and Usability & Accessibility**

Computer anxiety has been played a significant role in the adoption of health information systems. According to a study on the efficacy of internet-based Personalized Decision Support (PDS), computer anxiety demonstrated major effect on the individuals' perceptions of the tool. This study shows that people with high computer anxiety find the system less practical and usable. As a result, they are less likely to acquire knowledge or change their behavior toward accepting the system (Lindblom, Gregory, Wilson, Flight, & Zajac, 2011).

Despite the discussed significant role of computer anxiety, its correlation with the Usability and Accessibility in the Organizational layer is not supported in this study. Table 31 presents the defined paths, its coefficient and the rejected validity obtained in the analysis.

Table 31: Path Propositions and validations (Organizational Factors) Paths

| Proposition | Model Path                                                                                                 | Path Coefficients | Validation |
|-------------|------------------------------------------------------------------------------------------------------------|-------------------|------------|
| P4          | Lower Computer Anxiety among PHRs users corresponds with higher Usability and Accessibility of Using PHRs. | -0.034 (ns)       | Rejected   |

In contrast, Computer Anxiety did not significantly affect the Usability and the Accessibilities of the system. The possible justification behind the obtained result could associate with the low average of participants' age. 63% of our sample is in the age range of 18 and 34 years old. As the young population is more technical savvy, they are less likely encounter computer anxiety.

It should be noted that the perceived usability by young individuals is different than the one from elderly. As the young population has the confidence, they are more likely to have experience with the applications similar to personal health systems. Younger individuals could more easily interact with a system offering an average degree of usability while the elderly should be provided with a higher degree of usability to be able to perform the same set of tasks.

### 5.1.2 Environmental Layer

Environmental factors represent the constructs that are generally under the providers' control than users. Technological requirements are often considered prior or during the system implementation. Organizational factors deals with the policies, guidelines and strategic programs that support using the system among the users.

#### 5.1.2.1 Technical Factors

##### **Degree of Integration and Perceived Usefulness**

Two points of views regarding the integrity of PHRs and patients' perceived usefulness of the system are considered. First, PHRs provides better usefulness though integration with medical devices. For example, Minerva which is a portable personal health record (PHR) system, offers the Integration with medical diagnostic equipment under the feature Health Risk Assessment in their Professional Edition package (Schiavello & Shapiro, 2011). Second, the PHRs are integrated with other systems and platforms such as EHRs and EMRs to increase the amount of availability and accessibility of the health records. As it was revealed by (Cocosila, 2012), people would use PHRs only because they see the usefulness of these devices when seeking health information.

The Degree of Integration examined in this study did not have a significant relationship with the Perceived Usefulness of the PHRs customers. Table 32 illustrates the defined paths, its coefficient and the rejected validity obtained in the analysis.

**Table 32: Path Propositions and validations (Technical Factors)**

| Proposition | Model Path                                                                                                                  | Path Coefficients | Validation |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------|------------|
| P5          | Higher Degree of Integration of PHRs with other health systems is associated with higher Perceived Usefulness of the users. | 0.215 (ns)        | Rejected   |

According to the results of the open ended questions in Section 4.3, only 12% of the respondents specified the integration related capabilities as an important factor in their decision making regarding the use of PHRs. This yields the individuals' emphasize on the features that a PHRs system offer more than its ability to be compatible with other systems. In addition, since most of the participants are not currently dealing with any type of health issue,

they might be less concerned about the value of obtaining records from multiple sources in health activities or decision making.

#### **5.1.2.2 Organizational Factors**

##### **Awareness and Perceived Usefulness**

It is evident that the adoption of PHRs is facilitated by Public awareness-raising activities around rights & availability of access as well as targeted educational interventions (Pagliari, Detmer, & Singleton, 2007). These activities increase individual perception of the usefulness associated with personal health systems which eventually cause the user to start using the system.

Physicians have a vital role in the adoption of PHRs due to the lack of public awareness of the personal health systems. In addition to their role as the primary point of direct contact and due to the degree of dependency of patients to their healthcare providers discussed in the section 2.1.3, physicians could greatly influence their patients with conveying the message of PHRs potentials in health management.

As a result of the positive experience towards EHR usability and the fact that PHRs function in a similar way that an EHR does, physicians have a major contribution for promoting using PHRs by their patients. In a study (Agrawal, 2011), physicians who are EHR users were found to have greater awareness of PHR use by their patients. It can be concluded that physicians and health professionals in the point of contact with individuals are effective channel for increasing awareness on PHRs.

The assessment of the theoretical model has determined that awareness of PHRs is supported to increase the Perceived Usefulness among our participants.

**Table 33** demonstrates the defined paths, its coefficient and support obtained in the analysis.

**Table 33: Path Propositions and validations (Organizational Factors) Paths**

| Proposition | Model Path                                                                                         | Path Coefficients | Validation |
|-------------|----------------------------------------------------------------------------------------------------|-------------------|------------|
| P6          | Higher Awareness about PHRs among users corresponds with higher Perceived Usefulness of the users. | 0.338 (Sig)       | Supported  |

In the organizational layer, Awareness is identified as a key influencer in adopting PHRs among the individuals. Higher awareness could unhide different values and features that could assist individuals in managing their health condition.

### 5.1.3 Technology Acceptance Factors

The technological acceptance factors are explored in many studies within the context of HIT (Kim & Chang, 2007; Bickmore et al., 2010; Jung, 2008). In this study, two out of three propositions of the technology acceptance layer are supported.

#### Usability and Accessibility with Perceived Usefulness

The Usability and Accessibility examined in this study did not have a significant relationship with the Perceived Usefulness of the PHRs systems. Table 34 illustrates the defined paths, its significance and the rejected validity obtained in the analysis.

Table 34: Path Propositions and validations (Technology Acceptance Factors)

| Proposition | Model Path                                                                                                                          | Path Coefficients | Validation |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------|
| P9          | Higher level of Perceived Usability and Accessibility of PHRs among individuals increases their Perceived Usefulness of the system. | 0.113 (ns)        | Rejected   |

Based on the analysis, the Usability and Accessibility by itself is not a strong predictor to the users' Perceived Usefulness of the PHRs. As indicated in the section 4.4 (open ended question), most of the participants were more concerned on the features and functions that the system could provide than its ease of use and accessibility.

#### Usability and Accessibility with Behavioral Intention

The assessment of the theoretical model has determined that Usability and Accessibility associated with PHRs is supported to increase the customers' intention to using the system among our participants. Table 35 demonstrates the defined paths, its coefficient and support obtained in the analysis.

Table 35: Path Propositions and validations (Technology Acceptance Factors)

| Proposition | Model Path                                                                                                                        | Path Coefficients | Validation |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------|------------|
| P10         | Higher level of Perceived Usability and Accessibility of PHRs among individuals increases the customers' intention to using PHRs. | 0.285 (Sig)       | Supported  |

It could be concluded that Usability and Accessibility could directly increase the likelihood of using the system among individuals.

## Perceived Usefulness and Behavioral Intention

This study found that the Perceived Usefulness of the system is a significant predicator in users' acceptance of PHRs. The result of analysis confirms the correlation of these constructs in this study too. Hence, higher level of PHRs Usefulness is expected to increase individuals' intention to using the system. Table 36 presents the individual factors' defined paths, their coefficient and their validation results.

Table 36: Path Propositions and validations (Technology Acceptance Factors)

| Proposition | Model Path                                                                                                  | Path Coefficients | Validation |
|-------------|-------------------------------------------------------------------------------------------------------------|-------------------|------------|
| P11         | Higher level of Perceived Usefulness of the system among the users increases their intention to using PHRs. | 0.492 (Sig)       | Supported  |

## 5.2 Theoretical and Practical Contributions

### 5.2.1 Contributions to Theory

This study hopes to have contributed further to the body of knowledge on PHRs through the assessment of TAM in the context of SCT's three layers of factors. This research is consistent with the suggested future direction of the previous studies and is in effort in application of various theories and ideas. Our study addresses important concerns in PHRs adoption at the theoretical level. The theoretical contributions made from the research are presented in the following.

#### *5.2.1.1 Extending TAM Adoption Model in the Context of SCT*

Some of the studies regarding the adoption of PHRs such as Waghlikar, Fung, & Nelson (2012) developed their structural model based on the TAM while some other solely utilized the SCT (Assadi & Hassanein, 2009). In this study, the empirical model is developed based on the both theories.

The advantage of combining these theories enables us to classify the external variables that affect the perceived ease of use and perceived usefulness in the TAM model under individual, technical and organizational factors adopted from the SCT. In the construct basis, the study assessed the impacts of Degree of Integration suggested by (Snowdon, Shell, & Leitch, 2010, Information Accessibility suggested by (Alawneh, 2011) and Awareness suggested by Miller & Griskewicz (2008) in developing a PHRs adoption model for the first time.

#### *5.2.1.2 New Insights on the PHRs Adoption Model Interrelationships*

In our model, four new paths were identified which were not tested in the literature on the adoption of PHRs. The relationships of Social Norms with Usability and Accessibility, Behavioral Intention and Awareness have not been extensively tested in previous studies. Furthermore, this study created and examined the correlation of the Degree of Integration and Perceived Usefulness of the PHRs users for the first time.

Security and privacy, health literacy and computer anxiety have been identified as important barriers for using health information technology in many studies. We showed that these concerns can be significantly alleviated when PHRs achieve a high degree of social norm. Computer anxiety which belongs to situational anxiety can be decreased by proper training or increasing computer experiences (Snowdon, Shell, & Leitch, 2010. People would feel more safe

and secure and perceive a higher reliability of the system if they know that it is being widely used by the public. Social Norms increase people awareness and simultaneously improve their perception of system usability.

Degree of integration is also an important adoption factor for HIT systems. The increasing consumer demand in both the reach of receiving healthcare services (accessibility) and in depth information (detailed) from their providers, reveal the fact that the industry should be integrated from geographically-based pan-Canadian design in which the health information is consolidated at a provincial level (Snowdon, Shell, & Leitch, 2010).

#### ***5.2.1.3 New Insights on HIS implementation***

Our study demonstrates that the degree of integration does not statistically determine the successful adoption of PHRs. Moreover, the role of Social Norms was significantly identified as an important factor in increasing the users' awareness and also their perceived usability and accessibility of the system. These findings highlight the importance of environmental factors in both technical and organizational domains in planning and implementing personal health systems.

#### ***5.2.1.4 Answering calls for research***

Despite the numerous capabilities resulted from applications of technology to the healthcare context, limited number of studies has been conducted for assessing the drivers and obstacles of HIT adoption among the users. Also, to date, not much research has been conducted on the adoption of personal health systems. This study is an effort for answering the suggested calls for research from (Cohn 2006; Alkhatlan, 2010; Wilson & Peterson, 2010; Agarwal et al., 2013) and contributed to the existing body of knowledge in filling the gap in the area of PHRs adoption.

### **5.2.2. Contributions to Practice**

#### ***5.2.2.1 An implementation guide for providers***

In practice, the results of this study yields a number of important key factors in implementing and using PFIS services. Individual factors should be considered in determining users' needs before implementing patient facing systems. Faster adoption and acceptance of these systems are highly influenced by the level of norm associated with PFIS in the society. Moreover, awareness is a key to increase the level of Social Norms related to PFIS and eventually higher

intention of PHRs users. Finally, according to the conducted research, the system value has a larger weight on its features and functions (Usefulness) than its usability (Ease of Use). Respondents in this study were more concerned in solving their health issues through engaging in their health management activities offered by PHRs. A higher focus on offering services that provide value functions for consumers could significantly shorten the adoption process.

### **Individual factors**

#### **- Computer Anxiety and Intention to use**

To implement and adopt an effective personal health system, computer anxiety should be reduced. Providers should design different types of guidelines, online assistants and trainings for the system. It was suggested that proper computer training reduces the users' anxiety (Chuo et al., 2011). Since a significant portion of the users are elderly, these training should be simple, comprehensible and interactive. Moreover, these helps and training features should be delivered in a way that people with the most frequent disabilities such as vision impairment, hard of hearing and physical disabilities could be able to use them. According to the obtained results in our study, reduction of computer anxiety will then increase the intention to use PHRs.

#### **- Social Norms with Usability & Accessibility, intention to use and awareness**

Providers should implement strategies that could position using of PHRs as a norm in the society. For example, implement a trial period for beta version with minimum or no fee could potentially create some active users. Utilization of the system by a group increases the observability and spreads word of mouth about the product. Increased the number of users position the product as a norm among individuals. According to our statistical results, higher Social Norms increases the users' perceived usability of the product. Moreover, it enhances the level of product awareness among public and increases their intention to use the system.

### **Environmental factors**

#### **- Awareness and Perceived Usefulness**

This study highlighted the role of awareness in raising the perceived usefulness of the PHRs systems. Providers should establish integrated marketing campaigns and select the most appropriate tool set to communicate with their targeted market. For example, communication

could be through the advertisement and events in hospitals and clinics as well as public health sector.

Social media could be an appropriate channel for raising the awareness on PHRs. As it was figured in this study, the Social Norms is influenced from the people awareness as well. Raising Social Norms will consequently increase the perceived usefulness of the system. Since, social network environment is where people interact with their peers, friends, relatives and colleagues, government and private PHRs providers could take the advantages of the digital world to raise the awareness in the society.

#### ***5.2.2.2 PHRs characteristics matters to end users.***

As highlighted previously from the open ended question, most of the value of personal health system is perceived from the functionalities and features it could provide for the end users. Availability of the system, CRUD operations (Create, Read, Update and Delete), information comprehensibility and other beneficial features are identified crucial factors that users care about. It should be noted that the information under patients' control should be separated from the one physicians keep in their EHRs to minimum the risk of raising perceived loss of control among them.

Consistent with many other studies on the adoption of personal health systems, we figured that security and privacy really matters for health consumers. At the same time, people are not really activated in taking necessary steps in ensuring their security with information systems. Therefore, it is recommended to PHRs providers to using embedded and automated security features in their platforms that could provide a high degree of protection with minimum user effort.

#### ***5.2.2.3 Implications of the study for PHRs stakeholders***

##### **Implications for Designers/Developers**

This study has identified several important features and functions that a PHRs system could offer to health consumers. It was highlighted in the results of the open ended question and validated in our empirical model that consumers' perceived value from a PHRs system is highly influenced by its functionalities in the management of health records. Therefore, embedding useful features such as social tools are recommended to design and develop in these systems.

For example, PHRs with health 2.0 features not only could track inherited diseases among relatives and highlight the root cause in genetic health problems, but it could enable other family members to collaborate in the process of managing health conditions. A collaborative health management environment could significantly reduce the anxiety for health consumers (Baxter et al., 2001).

Moreover, developers should increase the security associated with the transmission of the health records. Encryption is one of the crucial techniques in the exchange of health information over the internet. As mentioned in the literature review, using protocols like HTTPS and 128 bit makes it difficult for intruder's to access the health information (Win, Susilo, & Mu, 2006).

### **Implications for Providers**

According to the high importance of organizational factors validated in our model, the adoption of PHRs systems could accelerate by raising public awareness about the values that the system could provide in self health management activities. For this purpose, designing and conducting marketing programs is suggested for PHRs service providers. Considering the large target market for health services, marketing activities should be highly effective so that more people could be aware of PHRs benefits with a limited amount of budget. Social media as a great tool in public health awareness (Newbold, 2011) could be the best medium for the first steps in this purpose.

### **Implications for Policy Makers**

Government and Policy makers are suggested to plan and support the widespread use of PHRs. This support could be obtained with the new policies that motivate providers to perform activities that shorten the adoption period for such systems (tax reduction for providers that serve larger numbers of consumer e.g.). Also, similar policies could motivate individuals to become PHRs consumers. For example, those who maintain their health records on PHRs systems might be offered with higher public insurance coverage than other individuals. If such policies enforce properly, health services could benefit public with a higher quality and cost effectiveness.

## 5.3 Study Limitations

The findings of this study are restricted by limitations in the survey methodology and the generalizability of the results. This section highlights those limitations and some possible ways to address them. Moreover, the discussion is followed by suggestions and further studies that could extend the literature review in this area.

### 5.3.1 Limitations in the survey methodology

The sampling procedure was non-random, self-selected and convenience basis. Despite the fact that the method offers a quick approach in gathering the required data, it might confound the justifications behind interpretive consistency (Collins et al., 2007) and the results cannot be generalized to the whole population (Chung & Tan, 2004). Moreover, self-selected sample participants are interested in the topic of the study and have a degree of bias (Keller, 2007).

The survey was conducted in a self-reported approach. It could not be determined from the survey that the respondents were in an ideal situation and their answers were not influenced by any environmental pressure and the “subjective norm”. The social influence is defined by (Bandyopadhyay & Fraccastoro, 2007) as “societal pressure on users to engage in a certain behavior”. Therefore, participants’ actual health condition might be different from what was reflected in the survey.

The number of participants that did not complete the survey is relatively high. Out of 200 responses, 70 are removed from the analysis. Future similar studies should either choose a larger sample size or set the survey to entice respondents for filling out the survey. During the analysis, the statistical mean was substituted for the missing fields. Although the number of missing fields is limited, this method could both reduce the variability and artificially increase the value of  $R^2$  while decreasing the standard errors (Allison, 2002). Other techniques can be used for missing fields in the future studies.

The last limitation of the survey is the combination of Information Accessibility and the perceived Ease of Use. Due to the similar obtained results from the two constructs it was decided to merge them into “Usability and Accessibility”. The relationship of the new attribute with the users’ perceived usefulness was not supported in this study. Therefore, we still believe that accessibility is a separate construct and the questions should be refined for future studies.

For this purpose, designing more specific and separate items with clearer borders is recommended.

### **5.3.2 Generalizability of the results**

The obtained results from this study cannot be generalized beyond the selected sample. In addition to the addressed statistical tendency of the responses, the bias still exists. Demographically, the participants were mostly young and do not represent the age distribution of the Canadian population.

For example, younger individuals should generally manage fewer amounts of health information than elderly. They might underestimate the value of a highly integrated personal health platform. Hence, in this study the Degree of Integration associated with PHRs does not have a significance relationship with users' Perceived Usefulness of the system.

Similarly, younger people are generally more tech savvy and are less likely to have Computer Anxiety compared to old people. Therefore, younger surveyed sample in this study could bias the relationship between users' Computer Anxiety and the Usability and Accessibility associated with PHRs systems as it is identified insignificant.

### **5.3.3 Survey participants**

The other limitation in this study is the degree in which participants interacted with the system. Having actual experience with personal health systems could reflect a different set of responses from the individuals as trialability has identified a facilitating factor in our literature review (section 2.5.2). As a result of challenges in the samples' classification, we expect a degree of bias in the results. We believe that this study provides a platform for future efforts and the research model should also be tested for different groups.

Moreover, it should be noted that consumers and physicians are not the only arrays of PHRs adoption. For example, health insurers, PHRs providers and the government should be considered in the development of the system adoption framework. A comprehensive model should be able to explain all major factors that play a role in this process.

## 5.4 Suggestions for Future Studies

In order to improve the quality of future studies on the adoption of personal health systems, a few points are suggested. This study is an effort to empirically examine the factors that affect the adoption of PHRs in Canada. The empirical model could be enhanced by examining new factors in the context of PHRs adoption.

As it was determined from the results of the data analysis, some of the suggested correlations in the previous studies are not supported. A focused investigation could also be conducted for assessing the rejected correlations to ensure the structural model validity.

An investigation over the PHRs implementation adoption factors is strongly suggested for the similar future efforts. They should include some critical aspects of the system design and change management in their implementation life cycle.

### **Conduct studies about actual PHR users and individuals with chronic condition**

As it was mentioned in our methodology, the sample from potential PHRs consumers was surveyed through a digital survey instrument. The obtained results of the survey could not be generalized to the actual users of the system since their behavior could be different towards the system. In the second chapter, patients with chronic conditions were determined as very open to the new tools and technologies that could assist their health management. Hence, the reliability of the outcome should be validated with the assessment of the actual personal health systems users.

### **Conduct studies about physicians and users**

In section 2.7, some of the barriers and drivers for healthcare professionals in the adoption of PHRs have been identified and discussed. Perceived loss of control, uncompensated workload, EHRs database privacy and resistant to change are the major factors. However, the obtained results are limited and need to be assessed by more in depth studies. Our methodology only focuses on the potential users of the system. However, the responsibility of information administration, promoting patients and integrating PHRs with other internal health systems highlight the physicians and other health professionals' role in the effective adoption of these systems.

### **Refining the model, determining other adoption factors**

Our literature review highlights some of the important factors in the adoption of PHRs. These factors assessed in the empirical model demonstrate a high explanatory power of 68.2 % of the variance in the adoption of PHRs. Nevertheless, this model could be improved by assessing other constructs that could affect the user intention. For example, the risk perception could significantly contribute in the PHRs adoption model. The risk perception of behaviors can affect individual and organizational choices (Gerberding, 2006). Another study highlights that patients' choice of participating in clinical trials is rather influenced by their perception of risk (Wright, Crooks, Ellis, Mings, & Whelan, 2002).

### **Experiment with exposing participants to PHR applications**

This study is limited to the potential users of the personal health system. In the future studies, individuals' behaviors that have a degree of experience with the system and its functionalities could be assessed. Exposing participants to different PHRs applications could help us in obtaining more accurate results as the participants have a better image of different ways that a personal health system could help them in taking care of their health condition in a practical way.

## **5.5 Conclusion**

This study aims to investigate the individual and environmental factors that influence the end-user adoption of Patient Facing Information Systems (PFIS) such as PHRs. After a secondary investigation of the available literature, a quantitative approach is adopted for formulating the concept to a structural model capable of explaining individuals' behavior. The analytical model is validated with various methods to ensure its reliability of the results. Eventually, most of the defined propositions in the model are supported. Further, the required justifications of the rejected relationships are explained.

The study highlights the PHRs user adoption factors in the context of the three layers of SCT. Individual factors are found to be very crucial in determining the user intention towards the PFISs. Specifically, lack of the required levels of Social Norms for PHRs among the people is identified as an important barrier for widespread adoption of the system. Finally, based on the high importance of the organizational layer factors, revealed in this study, providers and government have a vital role in promoting the value and benefits of the user-centered HIT systems such as PHRs.

## 6.0 Bibliography

Abdi, H. (2003). Factor rotations in factor analysis. *Encyclopedia of Social Sciences Research Methods*.

Adams, K., Greiner, A. C., & Corrigan, J. M. (2004). 1st Annual Crossing the Quality Chasm Summit: A Focus on Communities.

Agarwal, R., Anderson, C., Zarate, J., & Ward, C. (2013). If we offer it, will they accept? Factors affecting patient use intentions of personal health records and secure messaging. *Journal of Medical Internet Research*, 15(2), e43. doi:10.2196/jmir.2243

Aggelidis, V. P., & Chatzoglou, P. D. (2009). Using a modified technology acceptance model in hospitals. *International Journal of Medical Informatics*, 78(2), 115–126. doi:http://dx.doi.org/10.1016/j.ijmedinf.2008.06.006

Agrawal, E. (2011). ACCEPTANCE AND USE OF PERSONAL HEALTH RECORD: FACTORS AFFECTING PHYSICIANS' PERSPECTIVE. Indiana University. Retrieved from <http://scholarworks.iupui.edu/handle/1805/2682>

Ahern, D. K. (2012). Role of Patient-Facing Technologies in the Era of Health Reform Co-founder and Principal of Abacus.

Ahern, D. K., Woods, S. S., Lightowler, M. C., Finley, S. W., & Houston, T. K. (2011). Promise of and potential for patient-facing technologies to enable meaningful use. *American Journal of Preventive Medicine*, 40(5 Suppl 2), S162–72. doi:10.1016/j.amepre.2011.01.005

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. doi:http://dx.doi.org/10.1016/0749-5978(91)90020-T

Alawneh, R. (2011). Development of Embedded Personal Health Care Record System. *iBusiness*, 03(02), 178–183. doi:10.4236/ib.2011.32024

Alkhatlan, H. (2010). Evaluation of Young Adults' Preferences, Needs, and the Understandability of the Personal Health Record Data Contents. University of Pittsburgh. Retrieved from <http://d-scholarship.pitt.edu/8251/>

Allen, M.J and Yen, W.M. (1981). "Introduction to measurement theory." *Applied Psychological Measurement* (5:3), pp. 415-417.

Allison, K., & Evason, S. (2013). Applying Social Cognitive Theory to planning and evaluation : why and how ? MPH Health Promotion Coordinator, (March).

Allison, P. (2002). Sage Monograph on Missing Data (Sage paper # 136).

Allsop, D. J. C., & Ruhi, U. (2012). Online Personal Health Records: Investigating Adoption Factors. Project Report, University of Ottawa.

Alshumaimeri, Y. (2001). Research Methodology Chapter. Master Thesis. Retrieved from <http://faculty.ksu.edu.sa/yousif/Master%20Dissertation/Chapter%204%20Research%20Methodology.pdf>

Amato, S., Esposito Vinzi, V., Tenenhaus, M. (2004). A global goodness-of-fit index for PLS structural equation modeling. Oral Communication to PLS Club, HEC School of Management, France, March 24th.

Andrea, R. (2007). Health Level Seven's Personal Health Record Functional Model Approved as a Draft Standard for Trial Use. Retrieved from [http://www.hl7.org/documentcenter/public\\_temp\\_607886A1-1C23-BA17-0C36725E9DE680A4/pressreleases/HL7\\_PRESS\\_20071205.pdf](http://www.hl7.org/documentcenter/public_temp_607886A1-1C23-BA17-0C36725E9DE680A4/pressreleases/HL7_PRESS_20071205.pdf)

Andrews, D., Nonnecke, B., and Preece, J. (2003). "Electronic survey methodology: A case study in reaching hard-to-involve Internet users." *International Journal of Human-Computer Interaction* (16:2), 185-210.

Ant Ozok, A., Wu, H., Garrido, M., Pronovost, P. J., & Gurses, A. P. (2014). Usability and perceived usefulness of personal health records for preventive health care: A case study focusing on patients' and primary care providers' perspectives. *Applied Ergonomics*, 45(3), 613–628. doi:<http://dx.doi.org/10.1016/j.apergo.2013.09.005>

Arbor, A. N. N., December, U. S., & Seven, H. L. (2007). Health Level Seven, Inc. Contact : Andrea Ribick Health Level Seven's Personal Health Record Functional Model Approved as a Draft Standard for Trial Use, 1(January 2008), 1–3.

Archer, N., Fevrier-Thomas, U., Lokker, C., McKibbin, K. a, & Straus, S. E. (2011). Personal health records: a scoping review. *Journal of the American Medical Informatics Association : JAMIA*, 18(4), 515–22. doi:10.1136/amiajnl-2011-000105

Arocha, J. F., Hoffman, G. L. (2012). A survey of public health and consumer health informatics programs and courses in Canadian universities and colleges. *Informatic for health and social care*, 1-11.

Assadi, V., & Hassanein, K. (2009). Consumers' acceptance and use of personal health record systems: A theoretical model. In S. Newell, E. A. Whitley, N. Pouloudi, J. Wareham, & L. Mathiassen (Eds.), *ECIS* (pp. 895–906). Retrieved from <http://dblp.uni-trier.de/db/conf/ecis/ecis2009.html#AssadiH09>

- Bagozzi, R.P. (1996). Measurement in marketing research: Basic principles of questionnaire design. In R.P. Bagozzi (Ed.), *Principles of marketing research*, pp. 1-49. Oxford: Basil Blackwell.
- Bagozzi, R.P., and Yi, Y. (1988). "On the evaluation of structural equation models." *Journal of the Academy of Marketing Science* (16:1), pp. 74-94.
- Baird, Z. (2003). The Personal Health Working Group Final Report. Cspcs.sanford.duke.edu. Retrieved from [http://www.providersedge.com/ehdocs/ehr\\_articles/The\\_Personal\\_Health\\_Working\\_Group\\_Final\\_Report.pdf](http://www.providersedge.com/ehdocs/ehr_articles/The_Personal_Health_Working_Group_Final_Report.pdf)
- Baker, S. A., Morrison, D. M., Carter, W. B., & Verdon, M. S. (1996). Using the Theory of Reasoned Action (TRA) to Understand the Decision to Use Condoms in an STD Clinic Population. *Health Education & Behavior*, 23(4), 528–542. doi:10.1177/109019819602300411
- Ball, M. J., Smith, C., & Bakalar, R. S. (2007). Personal health records: empowering consumers. *Journal of Healthcare Information Management : JHIM*, 21(1), 76–86. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/17299929>
- Bandura, A. (1986). *Social foundations of thought and action : a social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura, a. (1989). Human agency in social cognitive theory. *The American Psychologist*, 44(9), 1175–84. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/2782727>
- Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision ...*, 50(2), 248–287. Retrieved from <http://www.sciencedirect.com/science/article/pii/074959789190022L>
- Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior : The Official Publication of the Society for Public Health Education*, 31(2), 143–64. doi:10.1177/1090198104263660
- Bandura, A. (2006). Guide for constructing self-efficacy scales. In: *Selfefficacy beliefs of adolescents*. *Information Age*, 307–337.
- Bandyopadhyay, K., & Fraccastoro, K. A. (2007). THE EFFECT OF CULTURE ON USER ACCEPTANCE OF INFORMATION TECHNOLOGY. *Association for Information*, 19(1). Retrieved from <http://aisel.aisnet.org/cais/vol19/iss1/23>
- Barlow, J., Crawford, W., & Lansky, D. (n.d.). *The Value of Personal Health Records*.

Bates, D. W., & Bitton, A. (2010). The future of health information technology in the patient-centered medical home. *Health Affairs (Project Hope)*, 29(4), 614–21. doi:10.1377/hlthaff.2010.0007

Baum, A. P., Abadie, F., Abadie, E. F., Lluch, M., Lupiañez, F. V., Maghiros, I., ... Talaya, Z. (2013). Strategic Intelligence Monitor on Personal Health Systems , Phase 2 : Market Developments – Remote Patient Monitoring and Treatment , Telecare , Fitness / Wellness and mHealth. doi:10.2791/83417

Baxter, C., Burke, J., Clowes, L., Cohen, M., Copeland, M. E., & Dolcino, C. (2001). *Mental Health, Mental Illness, Healthy Aging: A NH Guide for Older Adults and Caregivers*. Citeseer, 1(800). Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.201.6683&rep=rep1&type=pdf>

BC Ministry of Health. (2011). Self-Management Support : A Health Care Intervention.

Bell, Halley, Casey, Schooler, & Zaroukian. (2007). HIMSS Personal Health Records Definition and Position Statement Prologue. *Healthcare Information Management and Systems Society*, 1–13.

Bickmore, T., Vardoulakis, L., Jack, B., & Paasche-, M. (n.d.). Automated Promotion of Technology Acceptance by Clinicians Using Relational Agents.

Black, A. D., Car, J., Pagliari, C., Anandan, C., Cresswell, K., Bokun, T., ... Sheikh, A. (2011). The impact of eHealth on the quality and safety of health care: a systematic overview. *PLoS Medicine*, 8(1), e1000387. doi:10.1371/journal.pmed.1000387

Blair, W. (2006). Because Your Health Record Belongs To You. The Missing Link In Healthcare. Retrieved from <http://www.tmw.to/members.php?uri=lifecompass-personal-health-records-software-usb-key&viewpage=2>

Blue Button Plus Implementation Guide (2013). Evolution of Blue Button. Retrieved from <http://bluebuttonplus.org/history.html>.

Blumenthal, D., & Tavenner, M. (2010). The “meaningful use” regulation for electronic health records. *The New England Journal of Medicine*, 363(6), 501–4. doi:10.1056/NEJMp1006114

Brennan, P. F., Downs, S., & Casper, G. (2010). Project HealthDesign: Rethinking the power and potential of personal health records. *Journal of Biomedical Informatics*, 43(5 Suppl), S3–5. doi:10.1016/j.jbi.2010.09.001

Brown, J. (n.d.). iQuit : The use of Health Information Technology in Tobacco Treatment for College Students Part II.

- Bruno, V., & Dick, M. (2013). Improving Usability Outcomes for each of the Usability Practitioner Roles, 16(3), 173–188.
- Bryman, A. E., & Burgess, R. G. (1999). *Qualitative research*, Vol 4. London: Sage.
- Buettner, K., & Fadem, S. Z. (2008). The internet as a tool for the renal community. *Advances in Chronic Kidney Disease*, 15(1), 73–82. doi:10.1053/j.ackd.2007.10.002
- Burns, N., & Grove, S. K. (2003). *Understanding nursing research* (3rd Ed). Philadelphia, PA: W. B. Saunders.
- Bylund, C. L., Sabee, C. M., Imes, R. S., & Sanford, A. A. (2007). Exploration of the construct of reliance among patients who talk with their providers about internet information. *Journal of Health Communication*, 12(1), 17–28. doi:10.1080/10810730601091318
- Caligtan, C. a, & Dykes, P. C. (2011). Electronic health records and personal health records. *Seminars in Oncology Nursing*, 27(3), 218–28. doi:10.1016/j.soncn.2011.04.007
- Calvin, K. L., & Karsh, B.-T. (2009). A systematic review of patient acceptance of consumer health information technology. *Journal of the American Medical Informatics Association : JAMIA*, 16(4), 550–60. doi:10.1197/jamia.M2888
- Canada Health Infoway. (2011). *EHR: Advancing Canada's next generation of healthcare*. Retrieved from <http://www.v1.theglobeandmail.com/partners/free/infoway/pdf/2015%20Health%20care%20full%20report%20EN.pdf>
- Carson, L., & Kavesh, W. (2000). New Ways to Care for Older People: Building Systems Based on Evidence. *Journal of General Internal Medicine*, 15(5), 350–351. doi:10.1046/j.1525-1497.2000.02047.x
- Chau, P. Y. K., & Hu, P. J. (2002a). Examining a Model of Information Technology Acceptance by Individual Professionals: An Exploratory Study. *J. Manage. Inf. Syst.*, 18(4), 191–229. Retrieved from <http://dl.acm.org/citation.cfm?id=1289722.1289732>
- Chau, P. Y. K., & Hu, P. J.-H. (2002b). Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Information & Management*, 39(4), 297–311. doi:http://dx.doi.org/10.1016/S0378-7206(01)00098-2
- Chau, P., & Hu, P. (2001). Information Technology Acceptance by Individual Professionals: A Model Comparison Approach. *Decision Sciences*, 32(4), 699–719. doi:10.1111/j.1540-5915.2001.tb00978.x
- Cheung, C. M. K., Lee, M. K. O., & Rabjohn, N. (2008). The impact of electronic word-of-mouth: The adoption of online opinions in online customer communities. Emerald Group

Publishing Limited (Vol. 18, pp. 229 – 247). Emerald Group Publishing Limited.  
doi:10.1108/10662240810883290

Chin, W. W. (1998a). Issues and opinion on structural equation modeling. *Management Information Systems Quarterly*, (22:1), 7-16.

Chin, W. W. (1998b). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods in business research*, 295-336. Mahwah, NJ: Lawrence Erlbaum Associates.

Chin, W. W. (2001). *PLS-graph user's guide version 3.0*. Soft Modeling Inc.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study. *Info. Sys. Research*, 14(2), 189–217.  
doi:10.1287/isre.14.2.189.16018

Chismar, W. G., & Wiley-Patton, S. (2003). Does the Extended Technology Acceptance Model Apply to Physicians. In *Proceedings of the 36th Annual Hawaii International Conference on System Sciences (HICSS'03) - Track 6 - Volume 6* (p. 160.1–). Washington, DC, USA: IEEE Computer Society. Retrieved from <http://dl.acm.org/citation.cfm?id=820753.821635>

Christensen, K., Doblhammer, G., Rau, R., & Vaupel, J. W. (2009). Ageing populations: the challenges ahead. *Lancet*, 374(9696), 1196–208. doi:10.1016/S0140-6736(09)61460-4

Chung, J. and F.B. Tan (2004). “Antecedents of perceived playfulness: an exploratory study on user acceptance of general information-searching websites.” *Information and Management* 41, pp. 869-881.

Chuo, Y., Tsai, C., Lan, Y., & Tsai, C. (2011). The effect of organizational support , self efficacy , and computer anxiety on the usage intention of e-learning system in hospital, 5(14), 5518–5523.  
doi:10.5897/AJBM11.725

Clarke, J. L., Meiris, D. C., & Nash, D. B. (2005). Electronic personal health records come of age. *American Journal of Medical Quality : The Official Journal of the American College of Medical Quality*, 21(3 Suppl), 5S–15S. doi:10.1177/1062860606287642

Cocosila, M., & Archer, N. (2012). Consumer Perceptions of the Adoption of Electronic Personal Health Records: An Empirical Investigation, 1–11. Retrieved from <http://aisel.aisnet.org/amcis2012/proceedings/ISHealthcare/10/>

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New York, New York, USA: Lawrence Erlbaum Associates. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Statistical+Power+Analysis+for+the+Behavioral+Sciences#0>

- Cohen, L., & Manion, L. (1980). *Research Methods in Education*. London: Groom Helm Ltd.
- Cohn. (2006). *Personal Health Records and Personal Health Record Systems. A Report and Recommendations from the National Committee on Vital and Health Statistics*. Retrieved from <http://www.ncvhs.hhs.gov/0602nhiirpt.pdf>
- Collins, K.M.T., Onwuegbuzie, A.J., and Jiao, Q.G. (2007) “A mixed methods investigation of mixed methods sampling designs in social and health science research.” *Journal of mixed methods Research* (1:3), pp. 267.
- Copeland, & Keckley. (2008). *2008 Survey of Health Care Consumers*. The Deloitte Center for Health Solutions. Retrieved from <http://www.medretreat.com/templates/UserFiles/Documents/DeloitteConsumerHealthcareSurvey2008.pdf>
- Coughlin, M. A., & Knight, W. (2007). *Exploratory Factor Analysis (EFA) Publication*. Retrieved November 12th, 2008 from AIR/SPSS Professional Development Series [http://www.spss.com/airseries/part\\_one.pdf](http://www.spss.com/airseries/part_one.pdf)
- Cranney, A., Zarkadas, M., Graham, I. D., Butzner, J. D., Rashid, M., Warren, R., ... Switzer, C. (2007). The Canadian Celiac Health Survey. *Digestive Diseases and Sciences*, 52(4), 1087–95. doi:10.1007/s10620-006-9258-2
- Crisp, H. (2012). Do changes to relationships improve quality and save money ?, (June).
- Cronbach, L. J. (1951). “Coefficient alpha and internal structure of tests.” *Psychometrika* 16(3), pp. 297-334.
- Cronin, C. (2006). *Personal Health Records : An Overview of What Is Available To The Public* by, (April).
- Cruickshank, J., Packman, C., & Paxman, J. (2012). Putting patients in control ? *Personal Health Records*. 2020health.org, (September).
- Curtis, J., Cheng, S., Rose, K., & Tsai, O. (2011). Promoting adoption, usability, and research for personal health records in Canada: The MyChart experience. *Healthcare Management Forum*, 24(3), 149–154. doi:10.1016/j.hcmf.2011.07.004
- Darnton, A., & Sustainable, C. (2008). *GSR Behaviour Change Knowledge Review Reference Report : An overview of behaviour change models and their uses* Development , University of Westminster, (July).
- Davis, Bagozzi, & Warshaw. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, 35(8), 982–1003.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. Retrieved from <http://www.jstor.org/stable/249008>

Davis, F. D., Richard P. Bagozzi, & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, 35(8), 982–1003.

Delbanco, T., & Sands, D. Z. (2004). Electrons in Flight — E-Mail between Doctors and Patients. *The New England Journal of Medicine*, 350(17), 1705–7. doi:10.1056/NEJMp038209

Demiris, G. (2012). New era for the consumer health informatics research agenda. *Health Systems*, 1(1), 13–16. doi:10.1057/hs.2012.7

Deshazo, J. P. (2010). *The New Last Mile: PHRs and Patient Portals*. VCU Medical Center, Every day: A New Discovery.

Dick, R. S., Steen, E. B., & Detmer, D. E. (1997). *The Computer-Based Patient Record: An Essential Technology for Health Care*, Revised Edition. The National Academies Press.

Dick, R., & Steen, E. (1991). *The computer-based patient record: an essential technology for health care* (Vol. 2021, p. 2021). Retrieved from <http://books.google.com/books?hl=en&lr=&id=blwrAAAAYAAJ&oi=fnd&pg=PA1&dq=The+Computer-Based+Patient+Record:+An+Essential+Technology+for+Healthcare&ots=2l6Xblxvua&sig=qlpDALJqGpFaTGon4ggdgkvygX4>

DiClemente, C., Prochaska, J., & Gibertini, M. (1985). Self-efficacy and the stages of self-change of smoking. *Cognitive Therapy and Research*, 9(2), 181–200. doi:10.1007/BF01204849

Dimmick, S., & Burgiss, S. (2003). Outcomes of an integrated telehealth network demonstration project. *Telemedicine* .... Retrieved from <http://online.liebertpub.com/doi/abs/10.1089/153056203763317611>

Dolan, M., Wolter, J., Nielsen, C., & Burrington-Brown, J. (2009). Consumer health informatics: is there a role for HIM professionals? *Perspectives in Health Information Management / AHIMA*, American Health Information Management Association, 6, 1a. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2781724&tool=pmcentrez&rendertype=abstract>

Draper, J. (2004). The relationship between research question and research design. In P.A.

Dünnebeil, S., Sunyaev, A., Blohm, I., Leimeister, J. M., & Krcmar, H. (2012). Determinants of physicians' technology acceptance for e-health in ambulatory care. *International Journal of Medical Informatics*, 81(11), 746–760. doi:<http://dx.doi.org/10.1016/j.ijmedinf.2012.02.002>

Eaves.ca (2012). Public Policy: The Big Opportunity for Health Record Data. Retrieve from <http://eaves.ca/tag/health/>

Endsley, S., Kibbe, D. C., Linares, A., & Colorafi, K. (2006). An Introduction to Personal Health Records. *Family Practice Management*, 13(5), 57–62. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16736906>

Evashwick, C. J. (2005). *The continuum of Long-Term Care* (3rd ed.). NY.

Eyler, A. (2011). Consumer health informatics: Improving patient engagement. *Traditional Behavioral Medicine*. 1 (1): pp. 10.

Eysenbach, G. (2000). Consumer health informatics Health care in the information age, 320(7251), 1713–1716.

Eysenbach, G., & Jadad, A. R. (2001). Evidence-based Patient Choice and Consumer health informatics in the Internet age. Retrieved from <http://www.jmir.org/2001/2/e19/>

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods* 4, pp. 272-299.

Falk, R.F., and Miller, N.B. (1992). *A primer for soft modeling* University of Akron Press Akron, OH.

Field, E. J. (1996). Download Telemedicine : A Guide to Assessing Telecommunications for Health Care PDF Ebooks For Free - Committee on Evaluating Clinical Applications of Telemedicine ; Institute of Medicine ; Editor-Marilyn J . Field By Committee on Evaluating Clinical Appl, 28(2012).

Fisher, C. (2007). *Caring for Cancer: Create Your Own Personal Health Record*. ALEXIAN ADVANCED MEDICINE.

Flaherty, D. (2014). Evaluation of Consumer Health Informatics Definitions : A Systematic Review of the Peer-Reviewed Literature , 1995–2012.

Folker, G. (2007). *The Chronic Need for Connectivity: Helping today's aging health care consumers help themselves*. Ottawa: xwave healthcare.

Fornell, C. and D. Barclay. (1983). Jackknifing: A Supplement to Lohmoller's LVPLS Program. Ann Arbor, Michigan: University of Michigan.

Fornell, C., Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* 18 (1), 39-50.

- Fortney, J. C., Burgess, J. F., Bosworth, H. B., Booth, B. M., & Kaboli, P. J. (2011). A re-conceptualization of access for 21st century healthcare. *Journal of General Internal Medicine*, 26 Suppl 2, 639–47. doi:10.1007/s11606-011-1806-6
- Fox, S. (2010). *Cancer 2.0 : A summary of recent research*. Pew Research Center, 1–8.
- Fox, S., Jones, S. (2009). The social life of health information: Americans' pursuit of health takes place within a widening network of both online and offline sources. Retrieved from, <http://www.pewinternet.org/2009/06/11/the-social-life-of-health-information/>
- Francis, J. A., Abramsohn, E. M., & Park, H. Y. (2010). Policy-driven tobacco control. Retrieve from [http://tobaccocontrol.bmj.com/content/19/Suppl\\_1/i16.full](http://tobaccocontrol.bmj.com/content/19/Suppl_1/i16.full)
- Fuji, K. T., Galt, K. a, & Serocca, A. B. (2008). Personal health record use by patients as perceived by ambulatory care physicians in Nebraska and South Dakota: a cross-sectional study. *Perspectives in Health Information Management / AHIMA*, American Health Information Management Association, 5, 15. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2568896&tool=pmcentrez&rendertype=abstract>
- Galanis, C. (2014). *Connecting the dots for Better Healthcare*, (May).
- Gearon, C. (2007). *Perspectives on the Future of Personal Health Records*. California HealthCare Foundation iHealth Report. Retrieve from <http://www.chcf.org/publications/2007/06/perspectives-on-the-future-of-personal-health-records>
- Gefen, D., Straub, D., and Boudreau, M. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Structural Equation Modeling*. pp. 4-7.
- Gerberding, J. L. (2006). *Advancing the Nation's Health: A Guide to Public Health Research Needs, 2006-2015*. U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Centers for Disease Control and Prevention. Retrieved from <http://health-equity.pitt.edu/740/>
- Gibbons, M. C., Wilson, R. F., Samal, L., Lehman, C. U., Dickersin, K., Lehmann, H. P., ... Bass, E. B. (2009). Impact of consumer health informatics applications. *Evidence Report/technology Assessment*, 09(188), 1–546. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/20629477>
- Goldberg, L., Lide, B., Lowry, S., Massett, H. a, O'Connell, T., Preece, J., ... Shneiderman, B. (2011). Usability and accessibility in consumer health informatics current trends and future challenges. *American Journal of Preventive Medicine*, 40(5 Suppl 2), S187–97. doi:10.1016/j.amepre.2011.01.009
- Goldman, E. (2008). Google, Microsoft Vie to Lead Health IT Change. *Family Practice News*, 38(14), 49. doi:10.1016/S0300-7073(08)70925-3

- Graffigna, G., Barelo, S., & Riva, G. (2013). Technologies for patient engagement. *Health Affairs (Project Hope)*, 32(6), 1172. doi:10.1377/hlthaff.2013.0279
- Graffigna, G., Barelo, S., Wiederhold, B. K., Bosio, a C., & Riva, G. (2013). Positive technology as a driver for health engagement. *Studies in Health Technology and Informatics*, 191, 9–17. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/23792833>
- Grantham, D., & Brown, S. (2012). PAIN ASSESSMENT and MANAGEMENT Clinical Practice Guidelines, (April).
- Green S.B. & Salkind, N.J. (2003). *Using SPSS for Windows and Macintosh: Analyzing and understanding data* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.
- Green, B. B., Cook, A. J., Ralston, J. D., Fishman, P. a, Catz, S. L., Carlson, J., ... Thompson, R. S. (2008). Effectiveness of home blood pressure monitoring, Web communication, and pharmacist care on hypertension control: a randomized controlled trial. *JAMA : The Journal of the American Medical Association*, 299(24), 2857–67. doi:10.1001/jama.299.24.2857
- Greenes, R. A. & Shortliffe, E. H. (1990). Medical informatics An emerging academic discipline and institutional priority *JAMA : The Journal of the American Medical Association*, 263(8), pp. 1114-1120.
- Gritzalis, D., & Lambrinoudakis, C. (2004). A security architecture for interconnecting health information systems. *International Journal of Medical Informatics*, 73(3), 305–9. doi:10.1016/j.ijmedinf.2003.12.011
- Gysels, M., Richardson, A., & Higginson, I. J. (2007). Does the patient-held record improve continuity and related outcomes in cancer care: a systematic review. *Health Expectations*, 10(1), 75–91. doi:10.1111/j.1369-7625.2006.00415.x
- Harrison, M., Koppel, R., & Bar-Lev, S. (2007). Unintended consequences of information technologies in health care—an interactive sociotechnical analysis. *Journal of the American Medical ...*, 542–549. doi:10.1197/jamia.M2384.Introduction
- Hart, T. A. (2009). AN ASSESSMENT OF ATTITUDES TOWARD PERSONAL HEALTH RECORDS. Wichita State University.
- Hatton, J. D., Schmidt, T. M., & Jelen, J. (2012). Adoption of Electronic Health Care Records: Physician Heuristics and Hesitancy. *Procedia Technology*, 5, 706–715. doi:10.1016/j.protcy.2012.09.078
- Helena, V., & Katri, S. (2012). Personal health records and information management.

- Henriksen, K., Battles, J., & Keyes, M. (2008). Personal health records to improve health information exchange and patient safety, 1–10. Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK43760/>
- Hie-populated, A. (2011). CASE STUDY An HIE-populated personal health record for cardiac revascularization patients.
- Hietala, H., Ikonen, V., & Korhonen, I. (2009). Feelgood–Ecosystem of PHR based products and services. Retrieved from [http://feelgood.vtt.fi/FeelGood\\_finalreport.pdf](http://feelgood.vtt.fi/FeelGood_finalreport.pdf)
- Hildebrand, C., Jedamzik, S., Schulz, P. J., Dogac, A., Lamprinos, I., & Caylan, A. K. (2012). Strategies for Empowering Patients for Web-based Self-management, (288209).
- Hillestad, R., Bigelow, J., Bower, A., Girosi, F., Meili, R., Scoville, R., & Taylor, R. (n.d.). Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. *Health Affairs (Project Hope)*, 24(5), 1103–17. doi:10.1377/hlthaff.24.5.1103
- Hoerbst, A., Kohl, C. D., Knaup, P., & Ammenwerth, E. (2010). Attitudes and behaviors related to the introduction of electronic health records among Austrian and German citizens. *International Journal of Medical Informatics*, 79(2), 81–9. doi:10.1016/j.ijmedinf.2009.11.002
- Houston, T. K., Chang, BL., Brown, S., Kufafka, R. (2001). Consumer Health Informatics: A consensus Description and Commentary from the American Medical Informatics Association Members. Proceeding from the American Medical Informatics Association annual symposium 2001; pp 269-73.
- Howard, A. (2012). "Green Button" Open Data Just Created an App Market for 27M US Homes. Retrieve from [http://readwrite.com/2012/03/22/green\\_button\\_open\\_data\\_just\\_created\\_an\\_app\\_market\\_for\\_12\\_m\\_us\\_homes#awesm=~oyPpkNhG5plTIg](http://readwrite.com/2012/03/22/green_button_open_data_just_created_an_app_market_for_12_m_us_homes#awesm=~oyPpkNhG5plTIg)
- Hull, S. (2009). Organization of Nurse Leaders.
- Hung, S.-Y., Ku, Y.-C., & Chien, J.-C. (2012). Understanding physicians' acceptance of the Medline system for practicing evidence-based medicine: a decomposed TPB model. *International Journal of Medical Informatics*, 81(2), 130–42. doi:10.1016/j.ijmedinf.2011.09.009
- Ibanez, D., Dunne, S., Gaggioli, A., Ferscha, A., & Viaud-Delmon, I. (2011). Deliverable D1 . 3 : European HCC Map. *Human-Computer Confluence*, (October), 1–96.
- Iddleton, B. L. M., Ms, C., & Ates, D. A. W. B. (2008). A Research Agenda for Personal Health Records (PHRs ). 15(6), pp. 729–736.
- Igbaria, M. and Chakrabarti, A. (1990) Computer anxiety and attitudes towards microcomputer use. *Behaviour and Information Technology*, 9, pp. 229-241.

Iwaya, L. H., Gomes, M. a L., Simplicio, M. a, Carvalho, T. C. M. B., Dominicini, C. K., Sakuragui, R. R. M., ... Håkansson, P. (2013). Mobile health in emerging countries: a survey of research initiatives in Brazil. *International Journal of Medical Informatics*, 82(5), 283–98. doi:10.1016/j.ijmedinf.2013.01.003

Jaars, C. (2013). HIV knowledge and sexual risk behaviour of grade 12 learners in the Cape Metropole, Cape Town, (December). Retrieved from <http://ir1.sun.ac.za/handle/10019.1/85690>

Jahnke, J. H. W., Agah, A., & Williams, J. (2011). Consumer Health Informatics Services – A Taxonomy. Retrieve from <http://webhome.cs.uvic.ca/plab/documents/UVic-IPiRG-2011-TR-01.pdf>

Jarcho, J. M., Berkman, E. T., & Lieberman, M. D. (2011). The neural basis of rationalization: cognitive dissonance reduction during decision-making. *Social Cognitive and Affective Neuroscience*, 6(4), 460–7. doi:10.1093/scan/nsq054

Jeffs, D., & Harris, M. (1993). The personal health record. Making it work better for general practitioners. *Australian Family Physician*, 22(8). Retrieved from <http://europepmc.org/abstract/MED/8379881>

Jencks, S. (2009). Rehospitalizations among patients in the Medicare fee-for-service program. *New England Journal of ...*, 360(14), 1418–28. doi:10.1056/NEJMsa0803563

Jha, A.K., DesRoches, C.M., Campbell, E.G. et al. (2009). Use of Electronic Health Records in U.S. Hospitals. *New England Journal of Medicine* 360, no. 16, pp. 1628–38.

Jian, W.-S., Wen, H.-C., Scholl, J., Shabbir, S. A., Lee, P., Hsu, C.-Y., & Li, Y.-C. (2011). The Taiwanese method for providing patients data from multiple hospital EHR systems. *Journal of Biomedical Informatics*, 44(2), 326–32. doi:10.1016/j.jbi.2010.11.004

John H. Holmes. (2013). EHR Usability Toolkit. Annual Symposium. Retrieved from <http://www.amia.org/sites/amia.org/files/AMIA2013-onsite-program.pdf>

Johnson, T., Sohn, J., & Inman, W. (2013). Lipophilic stinging nettle extracts possess potent anti-inflammatory activity, are not cytotoxic and may be superior to traditional tinctures for treating inflammatory. *Phytomedicine*, 20(2). doi:10.1016/j.phymed.2012.09.016.Lipophilic

Jones, D. a, Shipman, J. P., Plaut, D. a, & Selden, C. R. (2010). Characteristics of personal health records: findings of the Medical Library Association/National Library of Medicine Joint Electronic Personal Health Record Task Force. *Journal of the Medical Library Association : JMLA*, 98(3), 243–9. doi:10.3163/1536-5050.98.3.013

Jones, R., McConville, J., Mason, D., Macpherson, L., Naven, L., & McEwen, J. (1999). Attitudes towards, and utility of, an integrated medical-dental patient-held record in primary care. *The British Journal of General Practice : The Journal of the Royal College of General*

Practitioners, 49(442), 368–73. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1313422&tool=pmcentrez&rendertype=abstract>

Jöreskog, K. G., Sörbom, D., & Magidson, J. (1979). *Advances in factor analysis and structural equation models*. Abt Books. Retrieved from <http://books.google.ca/books?id=bCe2AAAAIAAJ>

Jung, M. (2008). *From Health to E-Health: Understanding Citizens' Acceptance of Online Health Care*. Department of Business Administration and Social Sciences. pp. 68.

Kaelber, D., & Jha, A. (2008). A research agenda for personal health records (PHRs). ... the American Medical ..., 15(6). doi:10.1197/jamia.M2547.Introduction

Kahn, J. S., Aulakh, V., & Bosworth, A. (2009). What It Takes: Characteristics Of The Ideal Personal Health Record. *Health Affairs (Project Hope)*, 28(2), 369–76. doi:10.1377/hlthaff.28.2.369

Kaplan, A. M. and Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons*. Vol. 53, pp. 59-68.

Kappeler, E. (2013). *Health Information Resource Database*. Office of Disease Prevention and Health Promotion, U.S. Department of Health and Human Services.

Karray, F., Alemzadeh, M., Saleh, J. A., & Arab, M. N. (2008). *Human-Computer Interaction : Overview on State of the Art*, 1(1), 137–159.

Katerndahl, D., Parchman, M., & Wood, R. (2009). Perceived complexity of care, perceived autonomy, and career satisfaction among primary care physicians. *Journal of the American Board of Family Medicine : JABFM*, 22(1), 24–33. doi:10.3122/jabfm.2009.01.080027

Keller, G. (2007). *Statistics for Management and Economics Abbreviated*. Thomson /South-Western. 7th edition.

Kelpin, B. (2014). *Home Health Monitoring (HHM) A Sensible Approach*. Retrieved from <http://www.telushealth.co/telus-in-health/latest-thinking/>

Kennedy, C. (2013). *On Site Flu Shots*. Retrieve from <http://www.thehealthteam.ca/>

Kevin J. Leonard, M. C. and D. W. (2008). Who Will Demand Access to Their Personal Health Record? A focus on the users of health services and what they want. *Healthcare Quarterly*, 11(1), 92–96. Retrieved from <http://www.longwoods.com/product/19503>

Kharrazi, H., Chisholm, R., VanNasdale, D., & Thompson, B. (2012). Mobile personal health records: an evaluation of features and functionality. *International Journal of Medical Informatics*, 81(9), 579–93. doi:10.1016/j.ijmedinf.2012.04.007

- Kijsanayotin, B., Pannarunothai, S., & Speedie, S. M. (2009). Factors influencing health information technology adoption in Thailand's community health centers: applying the UTAUT model. *International Journal of Medical Informatics*, 78(6), 404–16.  
doi:10.1016/j.ijmedinf.2008.12.005
- Kim, D., & Chang, H. (2007). Key functional characteristics in designing and operating health information websites for user satisfaction: An application of the extended technology acceptance model. *International Journal of Medical Informatics*, 76(11–12), 790–800.  
doi:http://dx.doi.org/10.1016/j.ijmedinf.2006.09.001
- Kim, M. N. (2013). The Personal Health Record Paradox: Health Care Professionals' Perspectives and the Information Ecology of Personal Health Record Systems in Organizational and Clinical Settings. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3636319/>
- Kimmel, Z., Greenes, R., & Liederman, E. (2004). Personal health records. *The Journal of Medical ...*, 9(2), 171–180. Retrieved from <http://europepmc.org/abstract/MED/16471387>
- Kline, R. B. (2005). *Principles and practice of structural equation modeling*, Guilford Press.
- Kmiecik, T., & Sanders, D. (2009). *Integration of Genetic and Familial Data into Electronic Medical Records and Healthcare Processes* © By.
- Kohler, S. (2006). *Connecting for Health: A Public-Private Collaborative*. Cspcs.sanford.duke.edu, 1–7. Retrieved from <http://www.markle.org/publications/957-connecting-health-public-private-collaborative-convened-markle-foundation>
- Kothari, C. R. (2003). *Research methodology, methods and techniques*. New Delhi: Wisha Prakashan.
- Koufi, V. (2010). Ubiquitous access to cloud emergency medical services. ... and Applications in ..., 1–4. doi:10.1109/ITAB.2010.5687702
- Kowalczyk, N. (n.d.). Influence of gender, age, and social norm on digital imaging use. *Radiologic Technology*, 83(5), 437–46. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22596022>
- Krohn, R. (2007). The consumer-centric personal health record—it's time. *Journal of Healthcare Information Management*, 3(5), 60611. Retrieved from [http://www.researchgate.net/publication/6505370\\_The\\_consumer-centric\\_personal\\_health\\_record--it's\\_time/file/60b7d517680dfd5679.pdf](http://www.researchgate.net/publication/6505370_The_consumer-centric_personal_health_record--it's_time/file/60b7d517680dfd5679.pdf)
- Kronick, R. (2000). *Medical Errors: The Scope of the Problem*. Agency for Healthcare Research and Quality.

Lafky, D. B., & Horan, T. a. (2011). Personal health records: Consumer attitudes toward privacy and security of their personal health information. *Health Informatics Journal*, 17(1), 63–71. doi:10.1177/1460458211399403

LaMarca, N. (2011). The Likert Scale: Advantages and Disadvantages. Retrieved from <http://psyc450.wordpress.com/2011/12/05/the-likert-scale-advantages-and-disadvantages/>

Lankton, N., & Louis, R. S. (2005). USING PAPER-BASED SCENARIOS TO EXAMINE PERCEPTIONS OF INTERACTIVE HEALTH COMMUNICATION SYSTEMS.

Communications of the .... Retrieved from

<http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=15293181&AN=19323591&h=wRc6OIBzv6Hj%2FYNrHP2G%2BDn0%2B4DZ9SIUWLUMEYLR0QoExuuTp%2BFC9iVoQoPvYXSWUkqD%2Btile3aH7ga4hwnB%2Fg%3D%3D&crl=c>

Latham, B. (2007). Sampling: What is it? Quantitative Research Methods Course code: ENGL 5377. Retrieved from [http://webpages.acs.ttu.edu/rlatham/Coursework/5377\(Quant\)\)/Sampling\\_Methodology\\_Paper.pdf](http://webpages.acs.ttu.edu/rlatham/Coursework/5377(Quant))/Sampling_Methodology_Paper.pdf)

Lau, A. Y. S., Proudfoot, J., Andrews, A., Liaw, S.-T., Crimmins, J., Arguel, A., & Coiera, E. (2013). Which bundles of features in a Web-based personally controlled health management system are associated with consumer help-seeking behaviors for physical and emotional well-being? *Journal of Medical Internet Research*, 15(5), e79. doi:10.2196/jmir.2414

Leavitt, M., Tang, P., Agrawal, A., & Benoit, R. D. (2008). Guide for constructing self-efficacy scales. In: *Selfefficacy beliefs of adolescents*. In Certification Commission for Healthcare Information Technology. CCHIT.

Lee, S. M., Kim, I., Rhee, S., & Trimi, S. (2006). The role of exogenous factors in technology acceptance: The case of object-oriented technology. *Information & Management*, 43(4), 469–480. doi:10.1016/j.im.2005.11.004

Lei, P., Wu, Q., & Pennsylvania, T. (2007). *Introduction to Structural Equation Modeling : Issues*.

Leighton, C. (1999). *Health Reform and Priority Services*. Associates Inc., Harvard School of Public Health.

Lemelin, J., Fcfp, C., Humbert, J., Ec, R. N., & Hogg, W. (2008). Telehomecare for patients with multiple chronic illnesses Pilot study Recherche Télé-monitorage à domicile pour patients souffrant de plusieurs maladies chroniques, 54.

- Lever, S. (2013). Sustainability of the Canadian Health Care System and Impact of the 2014 Revision to the Canada Health Transfer, (September 2013). Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Sustainability+of+the+Canadian+Health+Care+System+and+Impact+of+the+2014+Revision+to+the+Canada+Health+Transfer#0>
- Lewis, T. E. (2003). Protecting patient privacy. *American Journal of Orthodontics and Dentofacial ...*, 124(3), A17. doi:10.1016/S0889-5406(03)00633-4
- Li, L. (2010). A critical review of technology acceptance literature. Retrieved April. Retrieved from [http://www.swdsi.org/swdsi2010/SW2010\\_Preceedings/papers/PA104.pdf](http://www.swdsi.org/swdsi2010/SW2010_Preceedings/papers/PA104.pdf)
- Li, M., Yu, S., Zheng, Y., & Ren, K. (2012). Scalable and Secure Sharing of Personal Health Records in Cloud Computing using Attribute-based Encryption, XX(Xx), 1–14.
- Libreri, C., & Graffigna, G. (2012). Mapping online peer exchanges on diabetes, 125–134. doi:10.7358/neur-2012-012-libr
- Lieberman, M. (2010). Social cognitive neuroscience. *Handbook of Social Psychology*, 143–193. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/9780470561119.socpsy001005/full>
- Lindblom, K., Gregory, T., Wilson, C., Flight, I. H. K., & Zajac, I. (n.d.). The impact of computer self-efficacy, computer anxiety, and perceived usability and acceptability on the efficacy of a decision support tool for colorectal cancer screening. *Journal of the American Medical Informatics Association : JAMIA*, 19(3), 407–12. doi:10.1136/amiajnl-2011-000225
- Lindeman, D., & Redington, L. (2010). Technologies for Improving. Center for Technology and Aging, (September).
- Liu, L. S., Shih, P. C., & Hayes, G. R. (2011). Barriers to the adoption and use of personal health record systems. *Proceedings of the 2011 iConference on - iConference '11*, 363–370. doi:10.1145/1940761.1940811
- Lober, W. B., Zierler, B., Herbaugh, a, Shinstrom, S. E., Stolyar, a, Kim, E. H., & Kim, Y. (2006). Barriers to the use of a personal health record by an elderly population. *AMIA ... Annual Symposium Proceedings / AMIA Symposium*. AMIA Symposium, 514–8. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1839577&tool=pmcentrez&rendertype=abstract>
- Logue, M. D., & Effken, J. a. (2013). Validating the personal health records adoption model using a modified e-Delphi. *Journal of Advanced Nursing*, 69(3), 685–96. doi:10.1111/j.1365-2648.2012.06056.x
- Luque, A. E., van Keken, A., Winters, P., Keefer, M. C., Sanders, M., & Fiscella, K. (2013). Barriers and Facilitators of Online Patient Portals to Personal Health Records Among Persons

Living With HIV: Formative Research. *JMIR Research Protocols*, 2(1), e8.  
doi:10.2196/resprot.2302

Ma, Q., & Liu, L. (2004). The technology acceptance model: a meta-analysis of empirical findings. *Journal of Organizational and End User Computing* ( .... Retrieved from <http://www.igi-global.com/article/technology-acceptance-model/3781>

Maibach, E. W., Weber, D., Massett, H., Hancock, G. R., & Price, S. (2006). Understanding consumers' health information preferences: development and validation of a brief screening instrument. *Journal of Health Communication*, 11(8), 717–36. doi:10.1080/10810730600934633

Maloney, F. L., & Wright, A. (2010). USB-based Personal Health Records: an analysis of features and functionality. *International Journal of Medical Informatics*, 79(2), 97–111. doi:10.1016/j.ijmedinf.2009.11.005

Marilyn J. Field, Ed. (1996). *Telemedicine: A Guide to Assessing Telecommunications for Health Care*. Washington DC: Committee on Evaluating Clinical Applications of Telemedicine, Institute of Medicine.

Marks, J. (2012). Top Tech Official Calls for New Panel to Help Liberate Government Data. Retrieve from <http://www.nextgov.com/cio-briefing/2012/05/top-tech-official-calls-new-panel-help-liberate-government-data/55941/>

Marquard, J. L., & Zayas-Cabán, T. (n.d.). Commercial off-the-shelf consumer health informatics interventions: recommendations for their design, evaluation and redesign. *Journal of the American Medical Informatics Association : JAMIA*, 19(1), 137–42. doi:10.1136/amiajnl-2011-000338

Martin, J., & McCaughtry, N. (2011). Using social cognitive theory to predict physical activity and fitness in underserved middle school children. ... *Quarterly for Exercise* ..., 82(2), 1–9. Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/02701367.2011.10599752>

Marton, C. (2011). Understanding how women seek health information on the web. Retrieved from <https://tspace.library.utoronto.ca/handle/1807/29808>

Mathieson, K. (1991). Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior. *Information Systems Research*, 2(3), 173–191. doi:10.1287/isre.2.3.173

McCray, A. (2005). Promoting health literacy. *Journal of the American Medical Informatics* ..., (October), 152–164. doi:10.1197/jamia.M1687.Addressing

McDaniel, A. M., Schutte, D. L., & Keller, L. O. (2008). Consumer health informatics: from genomics to population health. *Nursing Outlook*, 56(5), 216–223.e3. doi:10.1016/j.outlook.2008.06.006

- Mercer, D. A. (2013). Nonparametric Discriminant Analysis in Forensic Ancestry Estimation : An Assessment of Utilized and Alternative Statistical Methods.
- Miller, H., & Griskewicz, M. P. (2008). Personal Health Records (PHRs). Retrieved from, <http://www.himss.org/files/HIMSSorg/Content/files/mdng08final.pdf>
- Murray, A., Dimock, M., Mueller, E., Taylor, P., & Kohut, A. (2014). Health Fact Sheet. Retrieved from <http://www.pewinternet.org/fact-sheets/health-fact-sheet/>
- Murray, E., Burns, J., & See, T. (2005). Interactive Health Communication Applications for people with chronic disease. ... Database Syst Rev. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004274.pub4/pdf/standard>
- Nazi, K., Hogan, T., & McInnes, D. (2013). Evaluating patient access to electronic health records: results from a survey of veterans. Medical .... Retrieved from [http://journals.lww.com/lww-medicalcare/Abstract/2013/03001/Evaluating\\_Patient\\_Access\\_to\\_Electronic\\_Health.11.aspx](http://journals.lww.com/lww-medicalcare/Abstract/2013/03001/Evaluating_Patient_Access_to_Electronic_Health.11.aspx)
- Newbold, K. B. (2011). Media and Social Media in Public Health Messages : A Systematic Review Media and Social Media in Public Health Messages : A Systematic Review, (December).
- Noblin, A. M., Wan, T. T. H., & Fottler, M. (2012). The Impact of Health Literacy on a Patient ' s Decision to Adopt a Personal Health Record. *Perspect Health Inf Manag* 9, 1–13.
- Nokes, K. M., Verkuilen, J., Hickey, D. E., James-Borga, J. C., & Shan, J. (2013). Developing a personal health record self-efficacy tool. *Applied Nursing Research : ANR*, 26(1), 32–9. doi:10.1016/j.apnr.2012.06.001
- Norusis, M.J. (1990). SPSS/PC+Statstics (TM) 4.0: for the IBM PC/XT/AT and PS/2 SPSS, Inc., Chicago, IL.
- Nunnally, J.C. (1978). *Psychometric Theory*. McGraw Hill, New York.
- Nyanza, H. I. N., & Gilbert, M. (2013). USER ISSUES ON THE ADOPTION OF HEALTH INFORMATICS SYSTEMS IN LEVEL 5 Table 1 Years worked. *CONTEMPORARY RESEARCH IN BUSINESS*, 5(1), 277–291.
- Oftedahl, G., & Marshall, M. (2010). The future of personal health records: A summary of a roundtable discussion, 50–52.
- Oliver, N., & Flores-Mangas, F. (2006). HealthGear: a real-time wearable system for monitoring and analyzing physiological signals. *Wearable and Implantable Body ....* Retrieved from [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=1612896](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1612896)

- Or, C. K. L., & Karsh, B.-T. (n.d.). A systematic review of patient acceptance of consumer health information technology. *Journal of the American Medical Informatics Association : JAMIA*, 16(4), 550–60. doi:10.1197/jamia.M2888
- Pagliari, C., Detmer, D., & Singleton, P. (2007). *Electronic Personal Health Records: Emergence and Implications For The UK*. London: The Nuffield Trust.
- Parahoo, K. (1997). *Nursing research: Principles, process and issues*. Basingstoke: MacMillan.
- Parchman, M., & Pugh, J. (2007). Competing demands or clinical inertia: the case of elevated glycosylated hemoglobin. *The Annals of Family ...*, 196–201. doi:10.1370/afm.679.VERDICT
- Patient, R., & Diffusion, M. (2013). *Case Studies in Telehealth Adoption Centura Health at Home : Home Telehealth as the Standard of Care*, 2(January).
- Patterson, D., Ingram, D., & Kalra, D. (2012). *Information for clinical governance in: clinical governance making it happen*. The Royal Society of Medicine Press.
- PBGH (2009). *Personal Health Records (PHRs)*. Retrieved from [http://www.pbgh.org/storage/documents/reports/PBGH\\_PHR\\_IssueBrief.pdf](http://www.pbgh.org/storage/documents/reports/PBGH_PHR_IssueBrief.pdf)
- Perlich, A. (2012). *Designing an e-service for stroke patients—How can visualization support the management of the individual care process?*, (November). Retrieved from <http://opus.bsz-bw.de/hshn/volltexte/2013/64/>
- Peyman, N., Esmaily, H., Taghipour, A., & Mahdizadeh, M. (2013). Using of social cognitive theory: predictors of physical activity among women with diabetes type 2. *Health*, 3(2), 345–354. Retrieved from [http://www.sid.ir/en/VEWSSID/J\\_pdf/1038520130203.pdf](http://www.sid.ir/en/VEWSSID/J_pdf/1038520130203.pdf)
- Pichitchaisopa, N., & Naenna, T. (2013). Original article : FACTORS AFFECTING THE ADOPTION OF HEALTHCARE, 413–436.
- Polit, D.F., Beck, C.T., Hungler, B.P. (2001). *Essentials of nursing research: Methods, appraisal, and utilisation* (5th ed.). Philadelphia: Lippincott.
- Polzin, M. (2008). *Walgreens Partners with Google to Provide Pharmacy Patients Access to Their Prescription History Through Google Health*. Retrieved from <http://www.businesswire.com/news/home/20080519006465/en/Walgreens-Partners-Google-Provide-Pharmacy-Patients-Access#.UsdP0vRDs5Q>
- Popovich, M. L., & Rose, D. (2012). *Emerging Model*, 1–21.
- Preece, J., Rogers, Y. & Sharp, H. (2002). *Interaction Design: Beyond Human Computer Interaction*. New York, John Wiley & Sons.

Price, A. (2010). A study of factors influencing physician adoption of electronic medical records technology. Grenoble Ecole de Management. Retrieved from <http://libraryds.grenoble-em.com/fr/Publications/Theses DBA/Audrey Price.pdf>

Price, A. (2010). A study of factors influencing physician adoption of electronic medical records technology. Grenoble Ecole de Management. Retrieved from <http://libraryds.grenoble-em.com/fr/Publications/Theses DBA/Audrey Price.pdf>

Protti, D. J. (2007). The Past and Future Impacts of Health/Medical Informatics on Healthcare Delivery. Encyclopedia of Life Support Systems (EOLSS).

Raitoharju, R. (2007). Information Technology Acceptance in the Finnish Social and Healthcare Sector B Exploring the Effects of Cultural Factors. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:INFORMATION+TECHNOLOGY+ACCEPTANCE+IN+THE+FINNISH+SOCIAL+AND+HEALTHCARE+Exploring+the+Effects+of+cultural+Factors#0>

Rajkumar, L. (n.d.). Remote Patient Monitoring and Healthcare Applications, 1–9.

Rakestraw, E. (2009). One size doesn't fit all. Why HIPAA should not be extended to cover PHRS. International Journal of Medical Informatics, 30(2), 269–87.  
doi:10.1080/01947640902936597

Ralston, J. D., Revere, D., Robins, L. S., & Goldberg, H. I. (2004). Patients' experience with a diabetes support programme based on an interactive electronic medical record: qualitative study, 328(May).

Raza, S., & Standing, C. (2008). Systemic Problems in Information Technology Adoption and Use: A Systems Thinking Perspective. Retrieved from <http://ro.ecu.edu.au/ecuworks/1024/>

Report, F. (2003). The Personal Health Working Group Final Report.

Reti, S. R., Feldman, H. J., Ross, S. E., & Safran, C. (2010). Improving personal health records for patient-centered care. Journal of the American Medical Informatics Association : JAMIA, 17(2), 192–5. doi:10.1136/jamia.2009.000927

Ribick, A. (2011). The Accredited Standards Committee X12 HL7 Publishes Plan-to-Plan Personal Health Record ( PHR ) Data Transfer Implementation Guide HL7 Continuity of Care Document ( CCD ® ) Implementation Guide , paired with the ASC X12 275 Personal Health Record Transfe, 1–3.

Ridings, C. and D. Gefen. (2004). “Virtual Community Attraction: Why People Hang Out Online.” Journal of Computer Mediated Communication (10:1).

Rigdon, E. E. (1998). Structural equation modeling. In G.A. Marcoulides (Ed.). *Modern methods for business research*, pp. 251-294. Mahwah, N. J.: Lawrence Erlbaum Associates.

Rimer, B., & Glanz, K. (2005). *Theory at a glance: a guide for health promotion practice* .

Rohrer, J. E., Arif, A., Denison, A., Young, R., & Adamson, S. (2007). Overall self-rated health as an outcome indicator in primary care. *Journal of Evaluation in Clinical Practice*, 13(6), 882–888. doi:10.1111/j.1365-2753.2006.00766.x

Ross, E. S., Moore, A. L., Earnest, A. M., Wittevrongel, L., & Lin, C.-T. (2004). Providing a Web-based Online Medical Record with Electronic Communication Capabilities to Patients With Congestive Heart Failure: Randomized Trial. *J Med Internet Res*, 6(2), e12. doi:10.2196/jmir.6.2.e12

Royal College of Physicians and Surgeons of Canada. (2013). *National Physician Survey 2013 Backgrounder*.

Salah, H. (2013). Why Ontarians need access to personal health data and the Blue Button standard. Retrieve from <http://www.marsdd.com/2013/11/28/why-ontarians-need-access-to-personal-health-data-and-the-blue-button-standard/>

Salter, C. (2009). *The doctor of the future*. Fast Company, pp. 135-64.

Saparova, D. (2012). Motivating, influencing, and persuading patients through personal health records: a scoping review. *Perspectives in Health Information Management / AHIMA*, American Health Information Management Association, 9, 1f. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3392953&tool=pmcentrez&rendertype=abstract>

Schattner, P., Pleteshner, C., Practice, M. U. D. of G., Health, U. of M. D. of R., Ltd, M. D. of G. P., (Australia), G. P. C. G., & Ageing, A. D. of H. and. (2004). *The GPCG Computer Security Project: Final Report*. Melbourne: Monash University. Retrieved from <http://books.google.ca/books?id=JCeCPgAACAAJ>

Schiavello, D., & Shapiro, L. (2011). *Improving Quality and Coordination of Care and Services for Children with Special Health Care Needs and Their Families*. Retrieved from [http://www.wadsworth.org/newborn/nymac/docs/Schiavello\\_and\\_Shapiro.pdf](http://www.wadsworth.org/newborn/nymac/docs/Schiavello_and_Shapiro.pdf).

Schneider, J. M. (2010). Electronic and Personal Health Records: VA's Key to Patient Safety. *Journal of Consumer Health On the Internet*, 14(1), 12–22. doi:10.1080/02763860903543023

Schwartz, S. H. (1977). Normative Influences on Altruism. *Advances in Experimental Social Psychology*, 10, 221–279. Retrieved from [http://scholar.google.co.uk/scholar.bib?q=info:u\\_NJECOPpbQJ:scholar.google.com/&output=cit](http://scholar.google.co.uk/scholar.bib?q=info:u_NJECOPpbQJ:scholar.google.com/&output=cit)

ation&scisig=AAGBfm0AAAAAUMijn5DSMTUhwztJPsqWeKPr\_ZBiIGDI&scisf=4&hl=en&as\_sdt=0,5&as\_ylo=1977&as\_yhi=1977&as\_vis=1&scircf=1

Screen, P. H. R. (2011). Clinician guide to a personal health record, 1–14.

Sebelius, K. (2012). Health, United States, 2012: With Special Feature on Emergency Care. U.S. Department of Health and Human Services.

Serino, S., Cipresso, P., Gaggioli, A., & Riva, G. (2013). The Potential of Pervasive Sensors and Computing for Positive Technology : The Interreality Paradigm, 207–232.

Shah, S., Kaelber, D., & Vincent, A. (2008). A cost model for personal health records (PHRs). AMIA ... Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium, 657–61.

Retrieved from:

<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2656035&tool=pmcentrez&rendertype=abstract>

Shanholtzer, M. B. (2011). Integrated Electronic Health Records: A Worktext for Greenway Medical Technologies' Primesuite. (P. Mbadu, Danielle; Greenway Medical Technologies, Inc., Ed.). McGraw-Hill College.

Shipman, J. P., Kurtz-Rossi, S., & Funk, C. J. (2009). The health information literacy research project. *Journal of the Medical Library Association : JMLA*, 97(4), 293–301. doi:10.3163/1536-5050.97.4.014

Silow-Carroll, S., Edwards, J. N., & Rodin, D. (2012). Using electronic health records to improve quality and efficiency: the experiences of leading hospitals. *Issue Brief (Commonwealth Fund)*, 17(July), 1–40. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22826903>

Simon P. Cohn, & Permanente, K. (2006). Personal Health Records and Personal Health Record Systems. A Report and Recommendations from the National Committee on Vital and Health Statistics.

Smith, A. B., Odlum, M., Sikka, M., Bakken, S., & Kanter, T. (2012). Patient Perceptions of Pre-Implementation of Personal Health Records (PHRs): A Qualitative Study of People Living With HIV in New York City. *Journal of HIV/AIDS & Social Services*, 11(4), 406–423. doi:10.1080/15381501.2012.735166

Smolij, K., & Dun, K. (2006). Patient health information management: searching for the right model. *Perspectives in Health Information Management / AHIMA*, American Health Information Management Association, 3, 10. Retrieved from

<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2047307&tool=pmcentrez&rendertype=abstract>

- Snowdon, A., Shell, J., & Leitch, K. K. (2010). Personal health records: Helping consumers take the driver's seat. Deloitte Centre for Health Solutions.
- Solomon, C. (2013). Personal Health Records: Paving the way to continuity of care. High Hopes, High Expectations.
- Sood, S. P., Computing, A., Bornes, Q., Nwabueze, S. N., Louisiana, B. R., Mbarika, V. W. A., & Ray, P. (n.d.). Electronic Medical Records : A Review Comparing the Challenges in Developed and Developing Countries, 1–10.
- Stachura, M., & Khasanshina, E. (2007). Telehomecare and remote monitoring: An outcomes overview. *Adv. Med. Technol. Assoc*, 3. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Telehomecare+and+Remote+Monitoring+:+An+Outcomes+Overview#0>
- Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the AIS*, 13(24), pp. 380-427.
- Sukamolson, S. (2012). Fundamentals of quantitative research. Language Institute. Retrieved from <http://www.culi.chula.ac.th/e-Journal/bod/Suphat%20Sukamolson.pdf>
- Sun, Y., & Wang, N. (2013). UNDERSTANDING THE ACCEPTANCE OF MOBILE HEALTH SERVICES :, 14(2), 183–200.
- Swann, C., Carmona, C., Ryan, M., & Raynor, M. (2009). Health systems and health-related behaviour change: a review of primary and secondary evidence. Retrieved from <http://www.nice.org.uk/media/0E6/62/SpecialReportHealthSystemsAndHealthRelatedBehaviourChange.pdf>
- Tang, P., Ash, J., & Bates, D. (2006). Personal health records: definitions, benefits, and strategies for overcoming barriers to adoption. ... the American Medical ..., 13(2), 121–127. doi:10.1197/jamia.M2025.records
- Tang, P.C. & Lansky, D. (2005). The missing link: bridging the patient- provider health information gap. *Health Affairs*, 24(5):1290–5.
- Taylor, D. (2006). A Review of the use of the Health Belief Model ( HBM ), the Theory of Reasoned Action ( TRA ), the Theory of Planned Behaviour ( TPB ) and the Trans-Theoretical Model ( TTM ) to study and predict health related behaviour change, (June), 1–215.
- Teddle, C., Yu, F. (2007). Mixed Methods Sampling: A Typology With Examples. *Journal of Mixed Methods Research*. 1; 77. Vol1(1). Retrieved from, [http://wtgrantmixedmethods.com/pdf\\_files/Teddle%20and%20Yu\\_2007.pdf](http://wtgrantmixedmethods.com/pdf_files/Teddle%20and%20Yu_2007.pdf)

- Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M., and Lauro, C. (2005). "PLS path modeling." *Computational Statistics and Data Analysis* (48:1), pp. 159-205.
- Teo, T. (2009). The Impact of Subjective Norm and Facilitating Conditions on Pre-Service Teachers' Attitude toward Computer Use: A Structural Equation Modeling of an Extended Technology Acceptance Model. *Journal of Educational Computing Research*, 40(1), 89–109. doi:10.2190/EC.40.1.d
- Thatcher, J.B. & Perrewew, P.L. (2002). An empirical examination of individual traits as antecedents to computer anxiety and computer self-efficacy. *MIS Quarterly*, 26(4), pp. 381-396.
- Tim Bosenick. Consumers Compare Online Personal Health Record (PHR) Applications (2009). Retrieved from <http://go.galegroup.com/ps/i.do?id=GALE%7CA192958611&v=2.1&u=otta77973&it=r&p=AO NE&sw=w&asid=7f0c4f27a798a9af9a2667e5730ea28a>
- Tobias, R. D. (1994). An Introduction to Partial Least Squares Regression. Retrieved May 26, 2013 from <http://support.sas.com/rnd/app/stat/papers/pls.pdf>
- Tolba, A. H. (n.d.). Individual and cultural factors affecting diffusion of innovation, 1–16.
- Trochim, William, M.K. (2006). Nonprobability Sampling. *Research Methods. Knowledge Base*. Retrieved from, <http://www.socialresearchmethods.net/kb/samprnon.php>
- Unruh, K., & Pratt, W. (2007). Patients as actors: the patient's role in detecting, preventing, and recovering from medical errors. *International Journal of Medical Informatics*, 76 Suppl 1, S236–44. doi:10.1016/j.ijmedinf.2006.05.021
- VA Nebraska-Western Iowa Health Care System. (2008). Bariatric Nursing and Surgical Patient Care, 3(3), 183–187. doi:10.1089/bar.2008.9966
- Vashist, S. K. (2012). Non-invasive glucose monitoring technology in diabetes management: a review. *Analytica Chimica Acta*, 750, 16–27. doi:10.1016/j.aca.2012.03.043
- Vecchione, A. (2012). 9 Popular Personal Health Record Tools. Retrieve from <http://www.informationweek.com/healthcare/patient-tools/9-popular-personal-health-record-tools/d/d-id/1103871>
- Velicer, W. F., & Jackson, D. N. (1990). Component Analysis Versus Common Factor-Analysis – Some Further Observations. *Multivariate Behavioral Research*. 25(1), pp. 97-114.
- Veterans Administration (2013). Blue Button. Retrieved from <http://www.va.gov/bluebutton>

- Vishwanath, A. (2009). Using frames to influence consumer willingness to pay for the patient health record: a randomized experiment. *Health Communication*, 24(5), 473–82. doi:10.1080/10410230903025407
- Vita-Finzi, L., & McCarey, P. (2005). Preventing chronic diseases: a vital investment. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Preventing+CHRONIC+DISEASES+a+vital+investment#0>
- Wäckerle, A., Blöchliger-Wegmann, B., Burkhardt, T., Krähenmann, F., Kurmanavicius, J., & Zimmermann, R. (2010, December 1). Notes on a stick: use and acceptability of woman-held maternity notes. *European Journal of Obstetrics, Gynecology, and Reproductive Biology*. Elsevier Scientific Publishers. Retrieved from <http://linkinghub.elsevier.com/retrieve/pii/S0301211510003489?showall=true>
- Waegemann, C. P. (2002). Testimony Regarding Personal Health Records, National Committee on Vital and Health Statistics. Retrieve from <http://www.ncvhs.hhs.gov/020724p6.htm>
- Wagholikar, A., Fung, M., & Nelson, C. (2012). Improving self-care of patients with chronic disease using online personal health record. *The Australasian Medical Journal*, 5(9), 517–21. doi:10.4066/AMJ.2012.1358
- Walton, S., Bedford, H. (2007). Parents' use and views of the national standard personal child health record: a survey in two primary care trusts. *Child: Care, Health and Development* 33(6), pp. 744–748.
- Wang, M., Lau, C., Masten, F., & Kim, Y. (2003). Patient-centered health record linked to a referral service. *Researchgate.net*, (206). Retrieved from [http://www.researchgate.net/publication/228825355\\_Patient-centered\\_health\\_record\\_linked\\_to\\_a\\_referral\\_service/file/9fcfd510422cfa75e8.pdf](http://www.researchgate.net/publication/228825355_Patient-centered_health_record_linked_to_a_referral_service/file/9fcfd510422cfa75e8.pdf)
- Weaver, S. et al. (2011). "EHR Adoption in LTC and the HIM Value." *Journal of AHIMA* 82, no.1. pp. 46-51.
- Weidemann, B. R., & Fitzgerald, A. (2008). Mastering the art of writing quantitative research reports, (April).
- Weingart, S. N., Rind, D., & Tofias, Z. (2006). Who Uses the Patient Internet Portal? The PatientSite Experience, 13(1), 91–96. doi:10.1197/jamia.M1833.Background
- Wetzels, M., Odekern-Schroder, G., and Oppen, C.v. (2009) "Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration." *MIS Quarterly* (33:1), pp. 175-199.

- Wiederhold, B. K., & Riva, G. (2012). Positive technology supports shift to preventive, integrative health. *Cyberpsychology, Behavior and Social Networking*, 15(2), 67–8. doi:10.1089/cyber.2011.1533
- Wilcox, L. G., Gatewood, J., Morris, D., Tan, D. S., Feiner, S., & Horvitz, E. (2010). Physician Attitudes about Patient-Facing Information Displays at an Urban Emergency Department. *AMIA ... Annual Symposium Proceedings / AMIA Symposium*. AMIA Symposium, 2010, 887–91. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3041441&tool=pmcentrez&rendertype=abstract>
- Wiljer, D., Bogomilsky, S., & Catton, P. (2005). Getting results for hematology patients through access to the electronic health record. *Canadian Oncology ...*, 16(3), 154–64. Retrieved from <http://europepmc.org/abstract/MED/17523576>
- Wiljer, D., Urowitz, S., Apatu, E., DeLenardo, C., & Eysenbach, G. (2008). Patient accessible electronic health records: exploring recommendations for successful implementation strategies. *J Med Internet*.
- William Copeland, J., & Keckley, P. H. (2008). 2008 Survey of Health Care Consumers. The Deloitte Center for Health Solutions. The Deloitte Center for Health Solutions.
- Wilson, C., & Peterson, A. (2010). *Managing Personal Health Information : An Action Agenda*. AHRQ Publication, (10).
- Win, K. T. (2005). Reviewed articles A review of security of electronic health records. *Health Information Management*, 34(1), 13–18.
- Win, K. T., Susilo, W., & Mu, Y. (2006). Personal Health Record Systems and Their Security Protection. *Journal of Medical Systems*, 30(4), 309–315. doi:10.1007/s10916-006-9019-y
- Wothke, W. (2010). Introduction to structural equation modeling course notes. American Institute of Research. SAS Institute Inc. Book Code E1565.
- Wright, J. R., Crooks, D., Ellis, P. M., Mings, D., & Whelan, T. J. (2002). Factors that influence the recruitment of patients to Phase III studies in oncology. *Cancer*, 95(7), 1584–1591. doi:10.1002/cncr.10864
- Wu, J.-H., Shen, W.-S., Lin, L.-M., Greenes, R. a, & Bates, D. W. (2008). Testing the technology acceptance model for evaluating healthcare professionals' intention to use an adverse event reporting system. *International Journal for Quality in Health Care : Journal of the International Society for Quality in Health Care / ISQua*, 20(2), 123–9. doi:10.1093/intqhc/mzm074

- Wuerdeman, L., Volk, L., Pizziferri, L., Tsurikova, R., Harris, C., Feygin, R., ... Bates, D. W. (2005). How accurate is information that patients contribute to their Electronic Health Record? AMIA ... Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium, 834–8. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1560697&tool=pmcentrez&rendertype=abstract>
- Wynia, M. K., Torres, G. W., & Lemieux, J. (2011). Many physicians are willing to use patients' electronic personal health records, but doctors differ by location, gender, and practice. *Health Affairs (Project Hope)*, 30(2), 266–73. doi:10.1377/hlthaff.2010.0342
- Wynia, M., & Dunn, K. (2010). Dreams and nightmares: Practical and ethical issues for patients and physicians using personal health records *The Journal of Law, Medicine & Ethics*, pp. 64–73. doi: 10.1111/j.1748-720X.2010.00467
- Xie, J., Rooholamini, S., Pearson, D., Bergman, D., & Winograd, T. (2013). Barriers and Facilitators of Personal Health Record Adoption : A study of Low-Income Families with Children with Special Health Care Needs. Stanford University Medical Center, 4086.
- Yarbrough, A., & Smith, T. (2007). Technology acceptance among physicians. A new take on TAM. *Medical Care Research and Review*, 64(6), 650–672.
- Yasnoff, W. A., O'Carroll, P. W., Friede, A. (2006). Public Health Informatics and the Health Information Infrastructure. Retrieved from [http://link.springer.com/chapter/10.1007%2F0-387-36278-9\\_15#page-1](http://link.springer.com/chapter/10.1007%2F0-387-36278-9_15#page-1)
- Yu, P., Li, H., & Gagnon, M.-P. (2009). Health IT acceptance factors in long-term care facilities: a cross-sectional survey. *International Journal of Medical Informatics*, 78(4), 219–29. doi:10.1016/j.ijmedinf.2008.07.006
- Zhao, Shi-Zheng;, Suganthan, Ponnuthurai Nagaratnam; (2012).Comprehensive comparison of convergence performance of optimization algorithms based on nonparametric statistical tests. *IEEE Congress on Evolutionary Computation (CEC)*, pp.1-7.
- Zimenkov, C., & Ahmad, F. (2012). Connecting for Health Personal Health Working Group. York University.