Facilitators and Barriers to User Adoption of Electronic Health Record Systems

Facilitators and Barriers to User Adoption of Electronic Health Record Systems

by

Mohammadreza Najaftorkaman

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Supervisor: Dr Amir Hossein Ghapanchi

School of Information and Communication Technology
Griffith University, Gold Coast Campus
Queensland, Australia.
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ABSTRACT

Information Technology (IT) applications have brought massive changes in healthcare and health providers have shifted from paper-based systems to computerized ones. The electronic medical record (EMR) and personal health record (PHR) are good examples of the application of IT in healthcare settings. Despite the enormous benefits of the available applications in healthcare, the adoption of EMR in primary care has been identified at 38.4 percent in the U.S., in Denmark, almost 62 percent of doctors use EMR, while only 55 percent of Australian physicians apply EMR systems (Sicotte et al. 2016; Venkatesh et al. 2011). Furthermore, with regard to the PHR system, the Australian government's development of a national PHR system (personally controlled electronic health record (PCEHR) system) in 2010 was a part of their national e-health strategy to overcome common challenges such as medication errors, fragmented sources of health information, repetition of tests, an increase in chronic illness, workforce resource constraints, and individuals' changing expectations of technology. The Australian government expected that 500,000 users would register at the first release of the national PHR system; however, only 400,000 users have signed up to this system and of those, many registered but their records remain empty.

Thus, to fill this knowledge gap, this research consists of two parts to explore the barriers and facilitators to the adoption of EMR and PHR systems. The first study focuses on the EMR system that mainly involves health providers such as physicians, nurses, and clinicians. The aim of the EMR study is to gain an in-depth understanding of the barriers and facilitators to the adoption of EMRs by their users and the author applied an exploratory case study approach in

order to generate an in-depth understanding of EMR adoption in a real-life context. The results of EMR study is analyzed based on thematic analysis and grounded theory approaches to identify facilitators and barriers to the users' adoption of EMRs. The results of the EMR study are divided into ten major themes based on thematic analysis: (1) perceived benefits of EMRs, (2) perceived difficulties of EMR by users, (3) hardware/software compatibility, (4) job performance uncertainty, (5) ease of operation, (6) perceived risk, (7) assistance society, (8) user confidence, (9) organizational support, and (10) technological support. According to the grounded theory approach, the findings of the study show that the users' awareness is based on individuals' real knowledge and facts related to the system. Users' previous experience and computer literacy have a positive impact on their understanding/awareness. The data shows that EMR users that had better basic computer knowledge and prior experience with similar computer-based systems had better perceptions of using the EMR system. In addition, users' recognition and interpretation of sensory information (perception) related to EMR can be impacted by their understanding/awareness. If users increased their knowledge of EMR, they were more likely to perceive EMR as beneficial. On the other hand, individuals that did not have enough knowledge about the system believed that using EMR could negatively impact their autonomy and threaten patients' data.

The second study concentrates on the PHR system and specifically works on PCEHR, which involves Australian residents monitoring and managing their own health information. The aim of this section of the study is to aims to discover the relationships between individuals' health-promoting behaviors and PHR adoption. The Partial Least Squares (PLS) method implemented in SmartPLS is selected to perform a simultaneous evaluation of both the quality of measurement (the measurement model) and hypothesized relationships between the constructs (the structural model) in the PHR study. The outcome measures are based on the HBM, which is based on the understanding of individual perceptions of health-promoting

behaviors. The results show that perceived usefulness, perceived barriers, cues to action, and perceived confidence are directly associated with individuals' intention to use the PCEHR, while perceived susceptibility and perceived severity are not associated with it. In addition to having significant implications for research and theory, this study has several implications for practitioners, including policymakers, IT professionals, health practice managers, and EMR/PHR system developers.

STATEMENT OF ORIGINALITY

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

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Last but not least, I am deeply grateful to my mother and wife for their love and support during my doctoral studies. I truly could not have achieved this milestone without their support.

CHAPTER 1

INTRODUCTION

1.1 Overview

The first chapter aims to provide a brief summary of the key points. It begins by presenting a preliminary introduction to health informatics systems (Section 1.2), followed by a summary of the background study on electronic medical record (EMR) and personal health record (PHR) in Section 1.3, including EMR and PHR definitions, the perceived benefits of EMR and PHR in healthcare, and the adoption rate of these systems in different countries. Section 1.4 presents the significant problem of EMR and PHR adoption in healthcare. Next, this chapter elaborates on the purpose of this research (Section 1.5) and presents research questions (Section 1.6). Section 1.7 describes the potential significance of this research. Finally, Section 1.8 clarifies the key terms of the research, including health informatics, EMR, PHR, and PCEHR. Figure 1.1 presents the outline of Chapter 1.

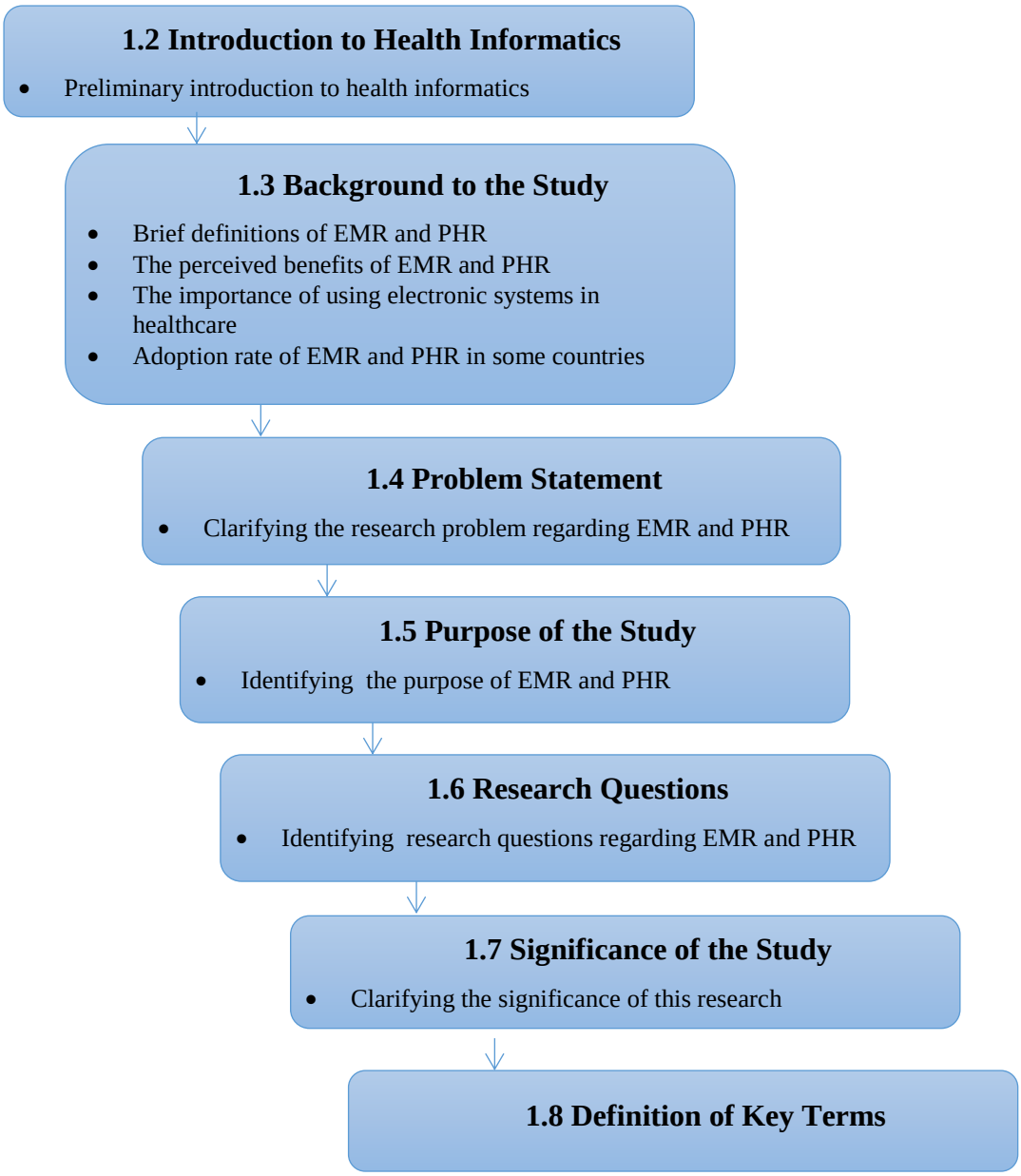

Figure 1.1 The outline of chapter one

1.2 Introduction to Health Informatics

Health information technology (health informatics) has become a focus for researchers, health practitioners top managers, and policymakers because they are beneficial in enhancing

operational efficiency, reducing medication errors, increasing adherence to guidelines, making the proper alerts, and decreasing costs (Jha et al. 2009; Yoshida et al. 2013).

For example, the Rand Research Corporation (Goldschmidt 2005; Otto and Nevo 2013), which is a nonprofit research organization, has estimated the potential benefits and costs of electronic health (e-health) and has described how actual health benefits can be achieved in the US healthcare system. Some of the potential benefits of e-health are efficiency savings, increased safety and better health. By adopting e-health in hospitals and doctors' offices, the annual efficiency savings can exceed $77 billion. Moreover, if the Computerized Physician Order Entry (CPOE) system was applied in hospitals, patient safety would be increased and annual savings would be about $1 billion. In addition, e-health can bring better health services and decrease the number of deaths by providing disease prevention and chronic-disease management systems.

Furthermore, the relationship between healthcare providers and patients have changed from paternalistic activity-passivity to being more patient-centered (Szasz and Hollender 1956). In the past, patients passively agreed with what their physicians told them, but in the patient's patient-centered relationship both the patients and the healthcare providers cooporate together to make healthcare decisions (Laine and Davidoff 1996). These relationships are significant in chronic disease treatment and patients have to act in partnership with their healthcare providers such as physicians and nurses to make better treatment decisions (Kuhn et al. 2006). In this way, the Internet plays an active role in increasing the health literacy of patients to enable them to participate in their healthcare (Pratt et al. 2006). Research has identified that if patients have a better understanding of their care, they can receive/choose more optimal treatment in partnership with their healthcare providers. Therefore, patients' empowerment and activation are two important concepts that can be used to improve quality of care (Butow et al. 2004;

Halamka et al. 2008; Samoocha et al. 2011). Nowadays, patients would like to be more active in their healthcare process and need to have access to health information in order to receive the best treatment. As a matter of fact, PHR is one of the best solutions to enhancing patients' gathering, understanding and controlling health information (Civan et al. 2006; Tang et al. 2006a).

Although there are several successful instances of e-health systems that have achieved a huge success in the health sector, it has been observed that most systems are abandoned after a while and experience failure regarding user adoption rate. For example, the American Hospital Association reported that almost 11% of health institutions used a fully applied electronic record system, and that these institutions were mainly large teaching hospitals located in urban areas (Vishwanath and Scamurra 2007). Furthermore, only 2% of hospitals in the USA have used comprehensive health record systems and almost 8% used the basic systems in at least one healthcare department (Jha et al. 2010). Moreover, according to a National Health Consumer Survey in the USA, only 10% of American adults currently use the PHR system (Nazi 2013). Finally, Australia has a personally controlled electronic health record (PCEHR), which is a secure system that stores and shares Australian health information. The Australian government anticipated that 500,000 users would register have access to health information in order to receive the best treatment when the system was first released. However, only 400,000 users have signed up to this PHR system, and of those, many just registered but their records remain empty. The majority of these accounts were created by healthcare professional for their patients. However, these patients never used this system. Addressing the current situation of the failure rate amongst e-health projects, the focus of the present research is on helping e-health projects become aware of the factors that impact on user adoption of these systems.

1.3 Background to the Study

Health informatics or e-health is an interdisciplinary subject that includes elements of healthcare, computer science, and information technology (IT). Information technology applications have brought about massive changes in healthcare and health providers have shifted from paper-based systems to computerized ones (Hillestad et al. 2005: 565). The electronic medical record (EMR) and the personal health record (PHR) are good examples of IT applications in healthcare settings.

The EMR is a computerized system that provides methods of collecting, storing and displaying health information. EMR systems have replaced paper records with digital records. They allow health information to be instantly available, and they enable the delivery of coherent and consistent healthcare (Ventura et al. 2011). The EMR systems involve patients' health records and are managed by health providers such as physicians, clinicians and healthcare institutions.

The PHR is a system that gathers the individual's health information from different health sources in order to assist health providers in understanding their needs and to improve the quality of their care. The PHR system includes the same types of health information as the EMR system. For example, family medical histories, healthcare provider contact information and allergies information, but it is designed to be accessed and managed by individuals such as patients (P. Tang et al. 2006b).

EMRs store information from all the healthcare professionals involved in a patient's care and all authorized clinicians involved in a patient's care can access the information to deliver care to that patient. However, PHRs contain the same types of information as EMRs such as medical history, family medical histories, diagnoses, medications, immunizations, but are designed to be set up, accessed, and managed by patients/individuals. For instance, the PCEHR

system is the National Australian PHR system which is accessible from the Internet. Individuals can share their health information with the healthcare providers and have access to medical information such as allergies information, over-the counter medications, and a child's immunization history. The PCEHR system has three major modules including: provider portal, consumer portal, and clinical system integration. The PCEHR system is able to connect to EMR systems in the healthcare organizations which helps healthcare professionals to view a shared health summary and add event summaries of their patients' health information (Showell 2011).

The perceived benefits of EMR include a reduction in human error; improved security of medical data; easier access to medical information; reduced duplication of efforts and documents; optimization of health data documentation; reduced cost of information and communication technology; support for decision-making activities; improved quality of care; and data repositories (Hillestad et al. 2005). PHR systems also have benefits for health consumers: individuals can access a wide range of credible health information and knowledge, and patients can monitor and manage their diseases by accessing their own health records. Collaboration can be increased between patients with chronic illnesses and caregivers by, for example, patients being able to ask questions, report problems, and set up appointments. Finally, PHR can integrate and combine information about an individual from multiple providers, and the system can improve care coordination (Tang et al. 2006a). Table 1.1 shows the summary of EMR and PHR definitions and benefits to the health systems.

In some cases, patients have to be treated by multiple healthcare providers in different health organizations, so providers need to access patients' information about various treatment processes. Information stored by health providers EMRs tells other clinicians in the emergency department about a patient's life-threatening allergy, and emergency staff can adjust care properly, even though the patient is unconscious. Furthermore, EMRs can provides accurate

medical history quickly and systematically compare to paper-based setting which collecting/recording comprehensive medical information is difficult approach.

Table 1.1 Summary of EMR and PHR systems

	Definitions	**Benefits of the system**
EMR	The EMR systems involve patients' health records and are managed by health providers such as physicians, clinicians and healthcare institutions.	Reduction in human error Improving security of medical data Easier access to medical information Reducing duplication of efforts and documents Optimization of health data documentation Reducing cost of information and communication technology Supporting for decision-making activities Improving quality of care Improving data repositories
PHR	The PHR system contains the same types of information as EMR such as medical history, family medical histories, diagnoses, immunizations, but are designed to be set up, accessed, and managed by patients/individuals.	Accessing a wide range of health information by individuals Monitoring and managing health conditions by individuals Improving collaboration between patients with chronic illnesses and caregivers (collaborative disease tracking) Reducing administrative costs Coordinating and combining information from multiple providers (providing integrated system)

Sanderson argued that the eight leading causes of death in the US are related to medical errors, and estimated that medical errors result in between 44,000 and 98,000 preventable deaths (Sanderson et al. 2004). These types of errors come from communication problems,

such as unreadable information because of illegible handwriting, mislabeled laboratory specimens, loss of medical records, and inaccurate health information in medical records. For example, it has been estimated that around 10 percent to 15 percent of prescriptions contain some type of error and 3.7 percent of medical error was related to loss of medical records (De Feijter et al. 2012). Furthermore, in a research which was done on the quality of Australian health care, researchers studied the medical records of 14,179 admissions to 28 hospitals in New South Wales and South Australia in 1995. An adverse event occurred in 16.6 percent of admissions, causing permanent disability in 13.7 percent of patients and death in 4.9 percent; 51 percent of adverse events were considered to have been avertable (Wilson et al. 1995). In Australia, 18 percent of medical errors happen form insufficient information nearly 30 percent unplanned hospital admissions are related to prescribing errors; and almost 13 percent of healthcare provider consultation suffers missing information (J. Xu et al. 2013).

1.4 Problem Statement

The electronic medical records in healthcare organizations and personal medical records are major systems that support efficient and effective healthcare procedures. Unfortunately, fewer healthcare organizations than expected have adopted such systems. Despite the enormous benefits of available applications in the healthcare, the adoption of EMR in primary care is identified as 38.4% in the US, in Denmark almost 62% of doctors use EMR, but only 55% of Australian physicians use EMR systems (Kruse et al. 2015; Pinaire 2009). Although a high adoption rate of EMR systems leads to improved healthcare, reduced medical costs, and large healthcare savings, such benefits are not yet evident and more research into EMR is needed. At this time, the researcher does not know why health providers resist adopting the EMR system, or what strategies might help to overcome the difficulties. A qualitative case study research method is needed to better understand the barriers to, and facilitators of, EMR

adoption. A case study is a useful research approach when researchers have limited control over the events being studied, and it is an effective method of answering the "how" and "why" questions in research.

Although there are various drivers within the healthcare system for PHR adoption by individuals, the actual adoption rate is still low (Birkhead et al. 2015; Jha et al. 2010). The PHR studies show that 42% of the US population tracks medical history for themselves and their family members, with 82% of these records in paper format and only 18% in the digital format (N Archer et al. 2011). Several research studies have discussed factors impacting on PHR adoption (D. Detmer et al. 2008; J. S. Kahn et al. 2009). As a matter of fact, there has been no research to provide a comprehensive adoption model to the Australian PHR system (PCEHR) because of the new system implementation. Little information is available on the PCEHR adoption, and there has been little focus on Australian healthy behavior and attitudes to self-care management. Furthermore, the elderly are the fastest growing population group in Australia. In fact, the internet has become an essential tool for living in recent years, many older Australians still have high levels of concern about using internet-based system in their daily life. Therefore, research should apply qualitative and quantitative approaches to discover the barriers to and facilitators of PCEHR adoption especially in the older Australians.

1.5 Purpose of the Study

This research consists of two parts that are designed to discover the facilitators of and barriers to health record systems. The first study uses a qualitative study method focusing on the EMR system, which mainly involves health providers such as physicians, nurses, and clinicians. The purpose of the EMR study was to explore the factors that impact on user adoption of EMR in order to successfully adopt the system and to improve the system's usability to achieve actual system use. Understanding the adoption factors that affect health

providers is necessary in order to determine the prerequisites for effective e-health projects in the healthcare industry. Consequently, this part of the research intends to investigate EMR adoption and its use by healthcare providers. In the EMR study, the researcher chooses qualitative approach because the number of participants was limited and qualitative approach could evaluate in depth and in detail of the subject. Generally, interviews are not limited to specific questions and can be redirected or guided by the researcher in real time to have comprehensive information. The main objective of the first study is:

RO1. To identify the factors involved with EMR adoption by healthcare providers.

The second part of this research concentrates on the PHR system and mainly involves individuals, such as patients, managing their information in the system. This quantitative study aims to discover the relationships between individuals' health-promoting behaviors and PHR adoption. In the PHR study, the researcher tries to find the relationship between independent variables and dependent variables in the research. The main objective of the second study is

RO2. To find out the relationships between individuals' health-promoting behaviors and PHR adoption.

In response to the current situation as per a low adoption rate for EMR and PHR systems, this research focuses on assisting e-health projects to increase their success by apprising healthcare providers and individuals of the adoption factors that may affect their success. The objective of this PhD dissertation, consequently, is to explore the factors impacting on EMR and PHR adoption by designing, developing, and testing a comprehensive research model. Therefore, this research will have significant implications for researchers and practitioners, including policymakers, marketers, IT professionals, health information management (HIM) practitioners, health practice managers, and EMR/PHR system developers.

1.6 Research Questions

Healthcare processes are highly collaborative and various people from different disciplines must work together to enhance the quality of care. The achievement of this goal has been revolutionized through the use of computer-based methods. EMR and PHR have become a focus for researchers, health practitioners and policymakers because they are beneficial in enhancing operational efficiency, reducing medication errors, increasing adherence to guidelines, making the proper alerts, and decreasing costs. The main research question that will help achieve the objective of this research by filling the above-mentioned gaps in the literature is as follows:

What are the factors involved with the adoption of electronic medical records used by healthcare providers and personal health records used by individuals?

There are numerous research studies on EMR adoption based on quantitative approach. In this part of study, the research investigates the nature of the healthcare professionals' experience of EMR use by addressing this research question: What are the factors involved in EMR adoption by healthcare providers? The main purpose of the EMR study was to explore the factors that impact on user adoption of EMR in order to successfully adopt the system and to improve the system's usability to achieve actual system use.

Furthermore, older people are the fastest growing population group in Australia. In fact, the internet has become an essential tool for living in recent years, many older Australians still have high levels of concern about using internet-based system in their daily life. Therefore, research should apply qualitative and quantitative approaches to discover the barriers to and facilitators of PCEHR adoption especially in the older Australians. There are limit studies have been focused on elderly using PHR system. Elderly adults may be willing to use the Internet as a source for general health information; however, when making decisions about their health

care, they seem to adhere to a physician-centered model of care. Thus, to fill this knowledge gap, this research focuses on elderly to find out the relationships between individuals' health-promoting behaviors and PHR adoption.

In the e-health research area, EMRs store information from all the healthcare professionals involved in a patient's care and all authorized clinicians involved in a patient's care can access the information to deliver care to that patient. However, PHRs are designed to be set up, accessed, and managed by patients/individuals. Therefore, this research covers all range of users (healthcare professionals and individuals) who interact with e-health systems.

In order to make a clear research question, the researcher divided this research into two sub-research questions. The first study applies a qualitative approach to find the factors affecting EMR adoption, and the second study uses a quantitative method to find the facilitators of and barriers to PHR adoption. The research questions in the first qualitative study explore and clarify the experience of healthcare providers' use of the EMR system. The research questions that help the researcher to achieve the objective of this research are as follows:

RQ1. What are the factors involved with EMR adoption by healthcare providers?

The second part of this research focuses on the adoption of PCEHR, Australia's National PHR system. This study asks the following research question:

RQ2. What are the individuals' health-promoting behaviors impact on PHR adoption?

1.7 Significance of the Study

This research is intended to make a significant contribution to the literature by investigating a set of factors affecting the adoption of electronic medical records and personal medical records. The result of this study draws the attention of top-level managers, policymakers,

decision-makers, application developers, IT professionals, general healthcare providers, and researchers working with health information technology to improve the patient's life. This study contributes to health information technology research in the following ways:

Firstly, the research involves the majority of users of health information technology. The EMR system is used in the research to find the adoption factors related to healthcare providers, and the PHR system is used to canvass individuals, for example patients, to assess their system acceptance. Furthermore, this research qualitatively evaluates healthcare providers' perceptions about facilitators of and barriers to EMR adoption; this step will bolster current quantitative research studies and provide a deeper understanding of EMR adoption. The goal of this part of the research is to gain an in-depth understanding of the barriers to and facilitators of the adoption of EMRs by their users and the researcher applied a qualitative approach in order to generate an in-depth understanding of EMR adoption in a real-life context. Investigation of adoption factors offers stakeholders in the health industry the information to work together in order to achieve the successful implementation of EMR system and its benefits, such as reduced cost of information and communication technology, support for decision-making activities, and improved quality of care. It reveals the role of top-level managers to motivate healthcare professionals to use EMR by providing more supporting policies and standards regarding patient safety improvement, documentation techniques, communication standards, and time management. Moreover, it uncovers the potential role of policymakers and IT professionals to engage in EMR adoption by providing professional development programs.

In addition, the PHR quantitative method study evaluates some new adoption constructs that are useful to add to the current PHR literature. The present research is one of the first studies to investigate adoption factors of Australia's National PHR system. The results of this

study will help to enhance the adoption rate of a personally controlled electronic health record (PCEHR) and find solutions to the system's barriers. This part of the research reveals the effects of practical workshops to increase individuals' knowledge, reduce technology-related concerns and increase self-efficacy regarding the use of PCEHR. Moreover, it explores the role of healthcare professionals in motivating their patients to upload their health-related information and share it with the healthcare sectors. For example, one of the main module of the PCEHR system is the provider portal, which helps healthcare professionals such as physicians, pharmacists, and advanced practice registered nurses to view a shared health summary and add event summaries of their patients' health information. The shared health summary is a clinical document written by a primary healthcare provider. It is a summary of an individual's health status at a single point in time and could include known allergies and adverse reactions, medications, medical history, and immunizations.

1.8 Definition of Key Terms

In this section, the researcher define key terms used in the present study.

Information technology (IT) is the applying of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data (Buntin et al. 2011).

Health informatics or e-health is an interdisciplinary subject that includes elements of healthcare, computer science and IT (Parnell 2013).

Electronic medical record (EMR) is synonymous with electronic health record (EHR). In most health informatics research, EMR and EHR are interchangeable. In this research, these terms have the same meaning and EMR is used as the more common term. EMR is a computerized system that provides methods of collecting, storing and displaying health

information. EMR systems have replaced paper records with digital ones, and they allow the instant availability of health information, enabling the delivery of coherent and consistent healthcare. The EMR systems involve patients' health records and are managed by health providers such as physicians, clinicians and healthcare institutions (Hillestad et al., 2005).

Personal health record (PHR) is a system that gathers consumers' health information from different health sources, and assists individuals in understanding and improving the quality of their care (Grant et al. 2008).

Personally controlled electronic health record (PCEHR) is a secure, electronic health record of an individual's medical history, which is stored and shared in a network of connected structures in Australia.

User adoption: In general terms, users adopt systems they either have to use, or that they want to use. If everyone at a company needs to use a specific system to complete their tasks, then the system will be adopted. In the e-health context, user adoption covers both healthcare professionals and individuals using e-health systems such as EMR or PHR.

Perceived susceptibility or perceived risk refers to the subjective evaluation of the risk of evolving a health problem.

Perceived seriousness or perceived severity refers to the subjective evaluation of the severity of a health-related problem and its possible effects.

Perceived benefits refer to possible benefits of health-promoting behavior to reduce the risk of the health problem.

Perceived barriers refer to possible barriers and difficulties to behavior change and health-promoting behavior.

Cues to action refer to internal or external triggers to perform a particular health behavior. For instance, cues to action can be the information from the media, friends, family member, and advertisements.

Self-efficacy refers to the individual's ability to perform a healthy behavior.

1.9 Summary

After the preliminary introduction (Section 1.2), this chapter provided a brief overview of EMR and PHR research background (Section 1.3). Next, the problem statement was proposed in order to present potential research gaps in EMR and PHR research (Section 1.4). Subsequently, the purpose of the study was derived by identifying the research questions (Section 1.5). Section 1.6 demonstrates the research questions that are intended to be answered by the present study. After that, the significance of the study was presented in order to highlight the research contribution to this subject to the literature (Section 1.7), followed by a definition of the key terms used in this study (Section 1.8). In the next chapter, the researcher provides background information and a review of the literature on EMR and PHR adoption.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This research consists of two studies to find out facilitators and barriers to EMR and PHR adoption. The first study focuses on the EMR system, which mainly involves health providers, such as physicians, nurses and clinicians. The second study concentrates on the PHR system and specifically focuses on the PCEHR which involves Australian residents in monitoring and managing their health information. Firstly, this chapter presents a review on EMR literature, including definitions of EMR, recent research areas in EMR literature and a discussion about EMR adoption. The researcher conducted a systematic review on EMR study and explained it on Sections 2.3.1 and 2.3.2.

The second part of this chapter focuses on PHR systems, including: PHR definitions, PHR adoption, and the PCEHR system. The researcher conducted a systematic review on PHR study and explained it on Sections 2.4.1. Next, this chapter covers theories that are useful in justifying EMR and PHR adoption, such as the theory of reasoned action, the theory of planned behavior, the technology acceptance model, the diffusion of innovation theory, the individual and family self-management theory, and the health belief model. Finally, the research gap is identified in EMR and PHR, based on the literature.

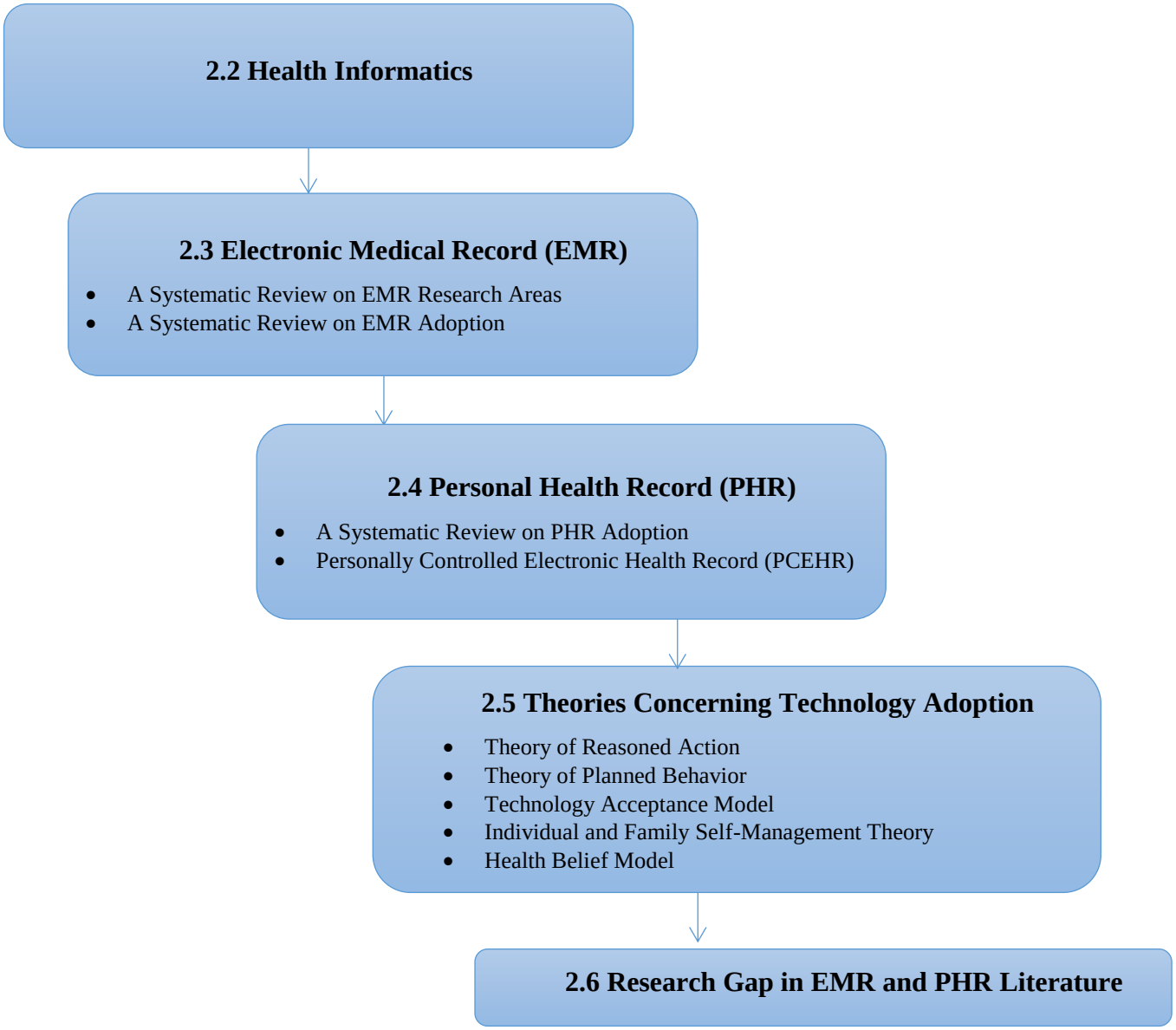

Figure 2.1 The outline of chapter two

2.2 Health Informatics

Health informatics or e-health is an interdisciplinary subject that includes elements of healthcare, computer science and information technology (IT). IT applications have brought about massive changes in healthcare and health providers have shifted from paper-based systems to computerized ones (Hillestad et al. 2005). It consists of various approaches, hardware, software, and resources to improve the acquisition, retrieval, and use of data in health-related areas. Health informatics tools, such as computers, information and

communication systems, health information system workflow, and formal medical terminologies are applied to the different areas of healthcare. The concept of health informatics emerged when computers were enabled to store and manage large amounts of data. Within the past decades, societies have been changed by the developments of various technologies (Szczerba and Huesch 2012).

Health informatics has brought various benefits to healthcare, such as a reduction in human error, improved security of medical data, easier access to medical information, reduced duplication of efforts and documents, optimization of health data documentation, reduced cost of information and communication technology, support for decision-making activities, improved quality of care, and data repositories. Furthermore, individuals can access a wide range of credible health information and knowledge, and patients can monitor and manage their diseases by accessing their own health information. Collaboration can be increased between patients with chronic illnesses and caregivers by using health informatics tools (Hillestad et al. 2005).

A virtual world technology, which is a computer-based simulated environment, is the latest IT technology in healthcare. It involves three-dimensional imaging and sounds that have been used in diagnosis, treatment and medical education. For example, this technology can help medical students to become more professional in obtaining the initial medical history of patients and physicals and analyzing information that comes from MRIs, CTs and X-rays. Furthermore, the designing of three-dimensional virtual body structures can help practitioners to view, explore and manipulate hundreds of organs (Janani et al.).

Health informatics brings various benefits to healthcare. It contributes to good health for the individual and provides comprehensive tools for representing, accessing and visualizing health data. It can provide comprehensive measurement and visualization of the human body

and applies formal models for a better understanding of the functions or workings of the human body. Furthermore, health informatics contributes to health knowledge. For example, it applies some data mining algorithms to analyze data from different perspectives and summarizes it into useful information. Next, health informatics contributes to well-organized healthcare by providing effective architecture of health information systems for patient-centered care and appropriate information management methods (Haux 2010).

Investing in computer technologies related to healthcare can radically improve the range and quality of care available to patients and medical specialists such as nurses, doctors, and clinicians. Health informatics can minimize the risk of medical errors and help the early detection of health problems. In-home tele-monitoring of patients with chronic problems such as heart diseases can improve survival rates by 15%, reduce hospital days by 25% and save 10% in nursing costs. Moreover, e-prescriptions can decrease errors in drugs dosage by 15% (Castro 2009).

2.3 Electronic Medical Record (EMR)

In this section, the researcher gives a brief overview of EMR then provide systematic reviews on the EMR research area and on EMR adoption.

The EMR is a computerized system that provides methods of collecting, storing and displaying health information. EMR systems have replaced paper records with digital records. They allow health information to be instantly available, and they enable the delivery of coherent and consistent healthcare (Ventura et al. 2011). The EMR systems involve patients' health records and are managed by health providers such as physicians, clinicians and healthcare institutions. Healthcare processes are highly collaborative and various people from different disciplines must work together to enhance the quality of care. The achievement of this goal has been revolutionized through the use of computer-based methods. For instance, EMR

is commonly used, replacing the paper medical record with a digital one. EMR can improve the quality of care and also reduce costs (Bleich and Slack 2010).

Electronic health systems can be compared to their paper-based counterparts in three major aspects: from the viewpoint of patients, general practitioners (GPs) and health providers (Deloitte 2006). For example, in paper-based systems, patients must physically transfer their health information from one provider to another, but in an electronic system all patient information is stored in the EMR database and health providers have access to patients' data.

Additionally, in a paper-based system, patients with chronic diseases, such as diabetes, cannot update their health progress frequently, but in an electronic system chronic care patients can easily update their medical records and have an active role in their treatment. Furthermore, in paper-based systems, health practitioners have some difficulties in obtaining relevant patient treatment information, but in electronic systems, patient information is stored in an integrated health record database and practitioners can build a better collaboration. Finally, by applying an integrated electronic system, health providers access more reliable and accurate information (Deloitte 2006).

Electronic medical records have become a focus for researchers, health practitioners and policymakers because they are beneficial in enhancing operational efficiency, reducing medication errors, increasing adherence to guidelines, making the proper alerts, and decreasing costs (Jha et al. 2009). The Rand Research Corporation (Goldschmidt 2005), which is a nonprofit research organization, has estimated the potential benefits and costs of electronic health (e-health) and has described how actual health benefits can be achieved in the US healthcare system. Some of the potential benefits of e-health are efficiency savings, increased safety and better health. By adopting e-health in hospitals and doctors' offices, the annual efficiency savings can exceed $77 billion. Moreover, if the Computerized Physician Order

Entry (CPOE) system was applied in hospitals, patient safety would be increased and annual savings would be about $1 billion. Finally, e-health can bring better health services and decrease the number of deaths by providing disease prevention and chronic-disease management systems (Goldschmidt 2005).

2.3.1 A Systematic Review on EMR Research Areas

Without doubt, EMR can have a significant influence on patient care, so it is important to categorize the various research areas involved. Although there have been numerous articles on EMR, there is still a research gap in terms of understanding the bigger picture of areas of EMR research. For example, in the literature there are numerous studies on design and development of the systems, EMR user adoption, and policy and standards. It is essential to categorize these areas to have a better picture of EMR and PHR in the literature. It is important for researchers and health practitioners to be aware of these different research areas. Based on an accurate classification of EMR research, different major challenges should be identified and resolved using scientific methods. In this section, the researcher conducted a literature survey and identified eight main categories: design and development; EMR impacts; adoption; integration; evaluation; medical research; EMR data design and management; and policy and standards. Some of these have subcategories that are described below (M. Najaftorkaman et al. 2013b).

2.3.1.1 Research methodology to conduct literature survey

This part follows literature survey guidelines to achieve research objectives. Literature survey is a comprehensive review of published and unpublished research works. This section elaborates research methodology of this study and identifies inclusion and exclusion of paper selection process (M. Najaftorkaman et al. 2013b).

Excellence in Research for Australia (ERA) is one of the best references available to measure quality of research. It uses indicators and research experts to rank research works (Haslam and Koval 2010). For this study, 10 journals in the areas of information systems, medical informatics, biomedical engineering and health informatics were selected. They are IEEE Transactions on Information Technology in Biomedicine; Computer Methods and Programs in Biomedicine; International Journal of Medical Informatics; Medical and Biological Engineering and Computing; BMC Bioinformatics; Artificial Intelligence in Medicine; BMC Health Services Research; Computers in Biology and Medicine; Journal of Biomedical Informatics; and BMC Medical Informatics and Decision Making. These journals, ranked A*, A, or B in ERA, are in different databases such as ScienceDirect, Scopus and IEEE Explore.

Each online database has a specific search pattern based on its search engine framework. Titles and abstracts of papers were searched using four main keywords: “Electronic Medical Record”, “EMR”, “Electronic Health Record”, and “EHR”.

In data analysis procedure, first of all following search process was done. In SienceDirect online database, expert search option was used and entered following search term to find suitable articles:

TITLE-ABSTR-KEY(“electronic medical record”) or TITLE-ABSTR-KEY(EMR) or TITLE-ABSTR-KEY(“Electronic health record”) or TITLE-ABSTR-KEY(EHR) AND LIMIT-TO(pubyr, "2012,2011") AND LIMIT-TO(cid, "272371","Journal of Biomedical Informatics")

This is an example finding articles in the Journal of Biomedical Informatics. This search term should be change based on journals’ title. Advanced search was used in Scopus database and following term was applied to find papers.

TITLE-ABS-KEY("electronic medical record") OR TITLE-ABS-KEY("electronic health record") OR TITLE-ABS-KEY(EHR) OR TITLE-ABS-KEY(EMR) AND (LIMIT-TO(PUBYEAR, 2012) OR LIMIT-TO(PUBYEAR, 2011)) AND (LIMIT-TO(EXACTSRCTITLE, "BMC Health Services Research "))

In IEEE Xplore database, the search was carried out based on the following search term and after that filter according to published date and title of journal.

(((((((("Abstract":Electronic medical record) OR Topic:EHR) OR Electronic health record) OR EMR) OR Topic:Electronic medical record) OR Topic:EHR) OR Topic:Electronic health record) OR Topic:EMR)

After identifying remaining papers based on inclusion and exclusion criteria and keywords, the researcher read the titles and abstracts of the extracted articles. At this stage he tried to assign appropriate labels according to the main area of research of the papers. Unfortunately, there were some papers for which this was not clear, so the researcher had to read the full text several times before assigning a final label. For example, some articles are closed to two or three categories.

Eventually, the researcher grouped the papers into eight major research categories and he tried to point out the grand challenges of EMR in the final stage. Figure 2.2 depicts the process undertaken to achieve the study aim.

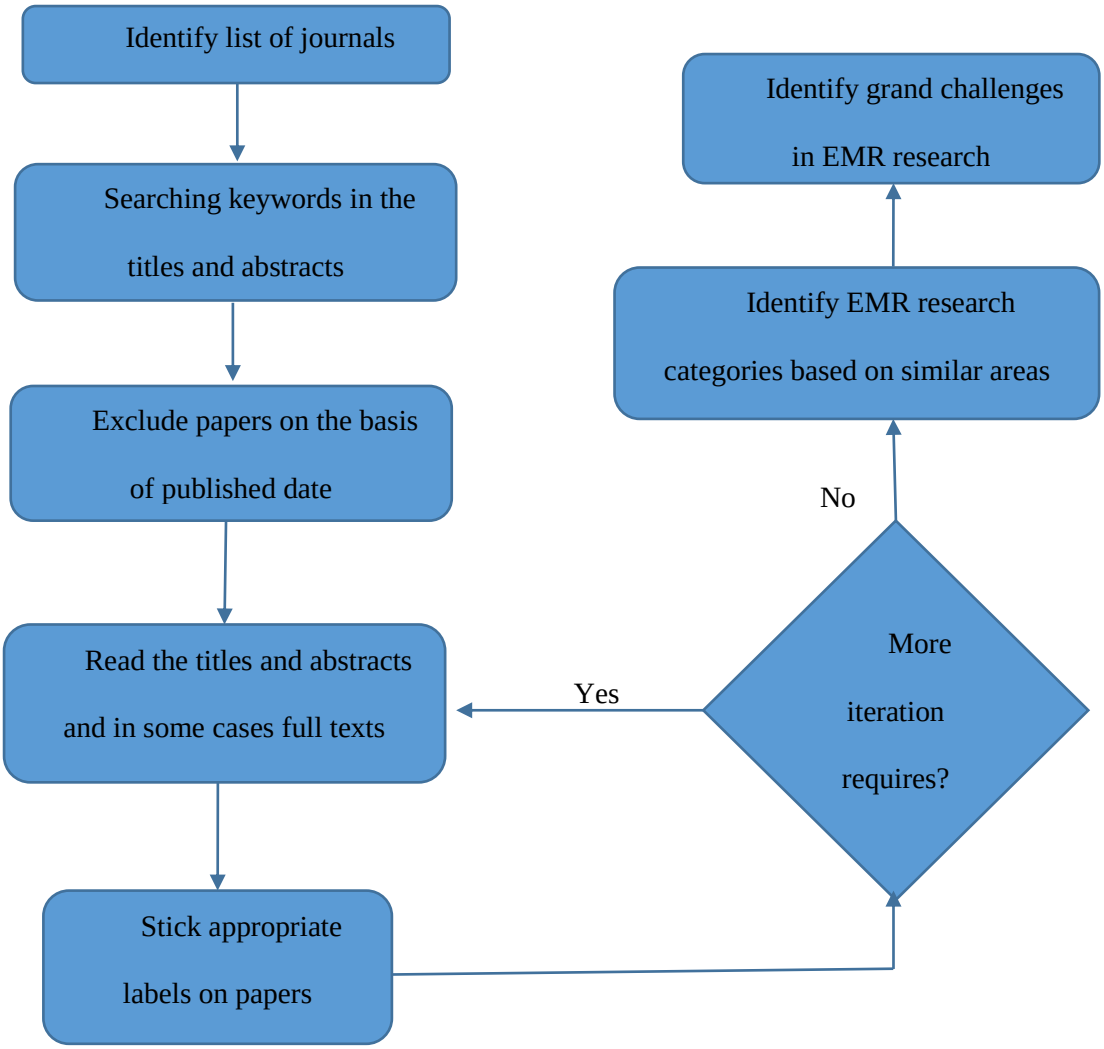

Figure 2.2 Stages of the research methodology to conduct systematic review

The Table 2.1 shows the number of papers (155 articles[1]) published in the 10 selected journals and the name of the database in which they found, as well as the rank of each journal according to ERA.

[1]Reference list for the literature survey can be accessed from the corresponding author's website at: https://sites.google.com/a/griffithuni.edu.au/torkman/recent-research-areas-and-grand-challenges-in-electronic-medical-record-a-literature-survey-approach

Table 2.1 List of journals included in the literature survey study

Name of Journal	Rank	Database	Number of papers
IEEE Transactions on Information Technology in Biomedicine	A*	IEEE Explore	9
Computer Methods and Programs in Biomedicine	A*	Scopus	2
International Journal of Medical Informatics	A	ScienceDirect	60
Medical and Biological Engineering and Computing	A	Scopus	0
BMC Bioinformatics	A	Scopus	1
Artificial Intelligence in Medicine	A	ScienceDirect	0
BMC Health Services Research	B	Scopus	16
Computers in Biology and Medicine	B	ScienceDirect	0
Journal of Biomedical Informatics	B	ScienceDirect	35
BMC Medical Informatics and Decision Making	B	Scopus	32
Total Papers			**155**

2.3.1.2 Eight Different Research Areas of EMR Research

The purpose of this study was to classify different areas of EMR research. The researcher identified eight main categories: design and development; EMR Impacts; adoption; integration; evaluation; medical research; EMR data design and management; and policy and standards (Figure 2.3). Some of these have sub categories that are described below (M. Najaftorkaman et al. 2013b).

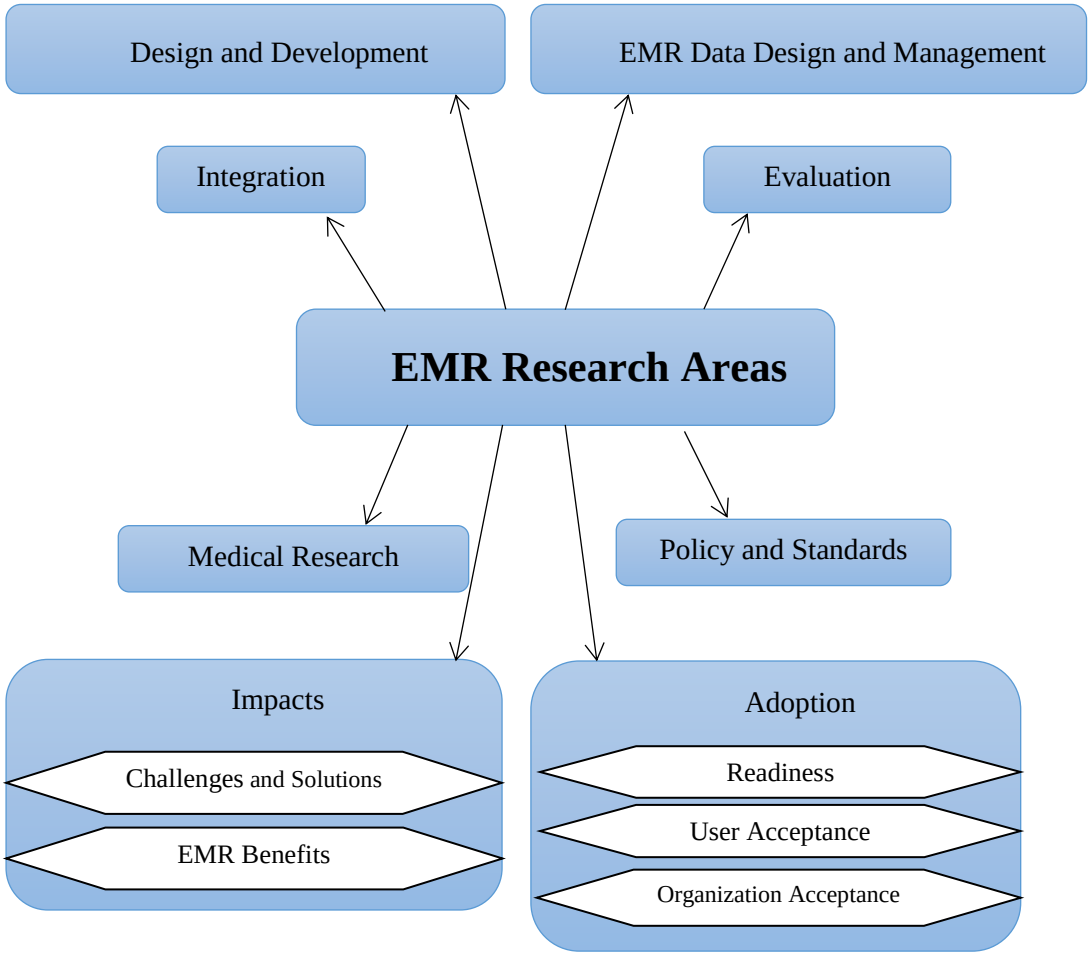

Figure 2.3 Research categories of EMR

In order to gain a general understanding of EMR research, the researcher (M. Najaftorkaman et al. 2013b) grouped all the recent studies on EMR into eight categories and

presented the number of EMR studies in Figure 2.4. Use of the EMR database in medical research and system evaluation had the largest number of articles (26 each). Twenty four papers were related to EMR data design and management, which is important in the development of EMR database. In contrast, although policy and standards have an important role to play in the implementation of EMR, only 10 papers were concerned with these aspects.

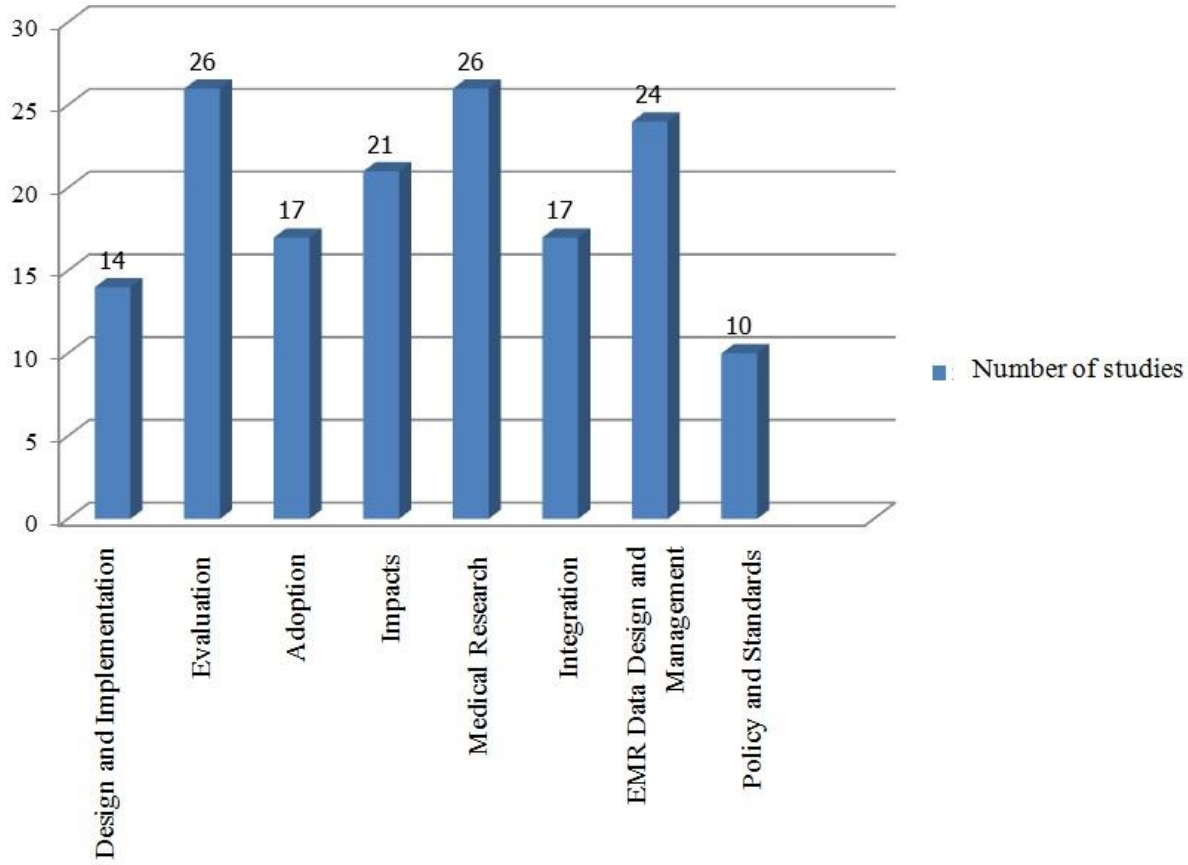

Figure 2.4 Number of studies based on EMR categories

2.3.1.2.1 Design and Development

In this category, different architectures are developed to improve EMR. There were 18 papers published on developing a model, architecture, prototype, management framework, application software and medical tools. For example, in 2011, Xiao and colleagues developed EHR architecture for methadone treatment. Their architecture has

some merits, such as supporting interoperability, decision support functionality and collaboration with international health standards (Liang Xiao et al. 2011b). Moreover, in some articles, researchers have developed tools or models to improve the use of EMR (Timbie et al. 2012). For instance, the US Centers for Medicare and Medical Services have developed EHR and have tried to design a Clinical Decision Support framework, which is one of the components of their medical programme to assist with medical records.

2.3.1.2.2 Evaluation

Almost all papers in this category focus on factors affecting EMR, comparing new and old e-health systems, customised health information systems, and quality and efficiency evaluation. For instance, McGinn assessed factors affecting Canadian record EHR based on applicability and importance (McGinn et al. 2012), and evaluated these factors during implementation and maintenance. The accuracy and availability of electronic patient record systems was evaluated by Lambdin (2012). He assessed the e-health system that was implemented for the treatment of HIV in Central Mozambique. Weihua and colleagues evaluated the development of EMR in developing countries, based on efficiency and efficacy evaluation and described the lack of customisation (Weihua and Akay 2011).

2.3.1.2.3 Adoption

There are three main subcategories in this category. The first is readiness, which focuses on organisational readiness and change management, in which different readiness factors are described to ameliorate healthcare delivery. For example, Yoo evaluated factors that affect the successful development of electronic record systems and assessed the challenges for future systems (Yoo et al.). The second subcategory is user

acceptance, which tests the acceptance of systems based on end users' estimations. For example, Scholl identified challenges and strategies for the development of successful EMR in a large hospital in India for end users who lack IT skills (Scholl et al. 2011). Finally, organisation acceptance evaluates the rate of adaptation software, hardware and communication systems. For instance, Yoon tried to identify the adoption rate of EHR in Korean general hospitals (Yoon et al. 2012).

2.3.1.2.4 Impacts

This category is divided to two main subcategories. The first one concentrates on the different challenges faced when implementing EMR, and offers some solutions to resolve these. The second subcategory concerns the benefits that show how EMR can improve healthcare in terms of quality, patient safety, cost, performance and computerised systems. For example, Walji and colleagues identified usability problems of EHR. They used multi- faceted methods to identify barriers and applied iterative design methods to solve problems (Walji et al. 2012). Also, the potential benefits of EMR in emergency medicine were evaluated by Feufel (2011).

2.3.1.2.5 Medical Research

In this category, EMR data which is stored in the software databases can be used for medical research. Patients' information stored in database software and health providers can use it in their health experiences in their future research. For instance, Prez-Cuevas in his paper "Evaluation of alternative standardized terminologies for medical conditions within a network of observational healthcare databases" tried to identify care indicators for type 2 diabetes using patient data extracted from EMR (Pérez-Cuevas et al. 2012). Moreover, Wood and colleagues have stored obesity-related

variables in an EHR database and use them to find the best obesity measurement (Wood et al. 2012).

2.3.1.2.6 Integration

All papers in this category are concerned with integration, interoperability and nationwide health information. There is an increasing demand for integrated medical record because healthcare has become more complex and fragmented into specialist areas. As a matter of fact, health practitioners' access to the accurate and relevant patients' information by using integrated EMR systems. For instance, Leonardo and colleagues focused on integrating reasoning and clinical archetypes using Ontology Web Language (OWL) (Lezcano et al. 2011). Additionally, Jose Alberto Maldonado in his paper" Using the ResearchEHR platform to facilitate the practical application of the EHR standards" presented a software platform to reach desired semantic interoperability (Maldonado et al. 2012).

2.3.1.2.7 EMR data Design and Management

EMR databases are one of the most important sources of Health Information Systems (HIS). This category describes data storage, exchange, privacy, security, data sharing, and documentation. For example, storing details of molecular variation in DNA, RNA, and proteins and other high volume molecular data in EHR is one of the major challenges in genetic healthcare systems (Masys et al. 2012). Furthermore, Prados-Suarez has proposed a contextualised access system for EHR in cardiology (Prados-Suarez et al. 2012).

2.3.1.2.8 Policy and Standards

Unfortunately, a lack of standards is one of the common problems with health information systems. There are just 10 papers that focus on policy and standards. For example, King assessed current policy and its development in Australia (King et al. 2012). Furthermore, the challenges, strengths, limitations and uptake of the HL7 context-aware knowledge retrieval standard were described by Del Fiol's study (2012).

2.3.2 A Systematic Review on EMR Adoption

This subsection aims to provide a comprehensive taxonomy of the factors influencing the user adoption of EMR and to classify these factors into meaningful categories. The researcher searched the selected keywords on several academic databases and found an initial set of 9684 studies. The researcher excluded papers on the basis of their title, abstract and full text (89 remaining papers). The effectiveness of adoption theories has been explored based on the empirical results identified in the EMR research. Furthermore, according to the conceptualization of the factors in the literature, a list of 78 factors affecting EMR adoption was identified. These factors were classified into eight categories: individual factors; psychological factors; behavioral factors; environmental factors; organizational factors; financial factors; legal factors; and technical factors. Finally, the results have implications for researchers and practitioners, including policymakers, marketers, IT professionals, Health Information Managers (HIMs), health practice managers, and EMR system developers.

Although there are many research papers on EMR adoption, there are only two systematic reviews of factors affecting EMR adoption (Table 2.2).

Table 2.2 Previous systematic literature reviews on factors affecting EMR adoption

Reference	Period of included papers	Final number of included papers	Number of main categories	Number of factors
(Castillo et al. 2010)	1985–2009	68	0	6
(Albert Boonstra and Broekhuis 2010b)	1998–2009	22	8	31

For example, Castillo and colleagues (2010) in their paper identified critical adoption factors for EHR by physicians, from 68 papers between 1985 and 2009. These included: user attitude toward information systems, workflow impact, interoperability, technical support, communication among users, and expert support.

Boonstra and his colleague (2010b) conducted a systematic review of 22 papers from 1998 to 2009, identifying barriers to the acceptance of EMR systems by physicians, which were divided into eight categories. The first category is financial and comprises four factors: high start-up costs; high ongoing costs; uncertainty about return on investment (ROI); and lack of financial resources. The second category comprises technical factors and is divided into eight factors: lack of computer skills of physicians and/or staff; lack of technical training and support; system complexity; system limitations; lack of customizability; lack of reliability; interconnectivity/standardization; and lack of computers/hardware. The third category is time, which is composed of five factors: time required to select, purchase, and implement the system; time to learn the system; time required to enter data; more time required per patient; and time to convert patient records. The fourth category is psychological, which is divided into two main factors: lack of belief in EMR, and the need for control. The fifth category relates to social factors, which include uncertainty about the vendor; lack of support from external parties;

interference with the doctor-patient relationship; lack of support from colleagues; and lack of support from management. The sixth category is legal and focuses on privacy and security concerns. The seventh category is related to the size and type of the organization concerned. The eighth category is change processes, which pertains to a lack of support from the organizational culture; lack of incentives; lack of participation; and lack of leadership (Albert Boonstra and Broekhuis 2010b).

2.3.2.1 Research Methodology to Conduct Systematic Review on EMR Adoption

A systematic literature review is a kind of research methodology that works on a topic or research question, and tries to identify, assess and interpret available empirical studies (M. Najaftorkaman et al. 2013a) (Kitchenham and Charters 2007). Kitchenham identified three main steps for conducting systematic literature reviews: planning the review, conducting the review, and reporting on the review (Kitchenham and Charters 2007). The same approach is followed in this study, and the researcher applied Ghapanchi's research approach (2011) as follows: (1) finding research resources; (2) study selection; (3) data synthesis; and (4) presenting the results.

Nine databases were used to search keywords related to EMR adoption. They are Science Direct, Scopus, ProQuest, PubMed, IEEE Xplore, ACM Digital Library, Association for Information Systems electronic library, SpringerLink, and ISI Web of Science.

There are three main categories of search terms. The first category focuses on EMR concepts, the second category emphasizes adoption terms and definitions and the last category concentrates on impact terminologies. Figure 2.5 shows the three categories of search terms that were used in this study. As a matter of fact, the researcher was looking for relevant articles that evaluated different factors impacting on EMR adoption.

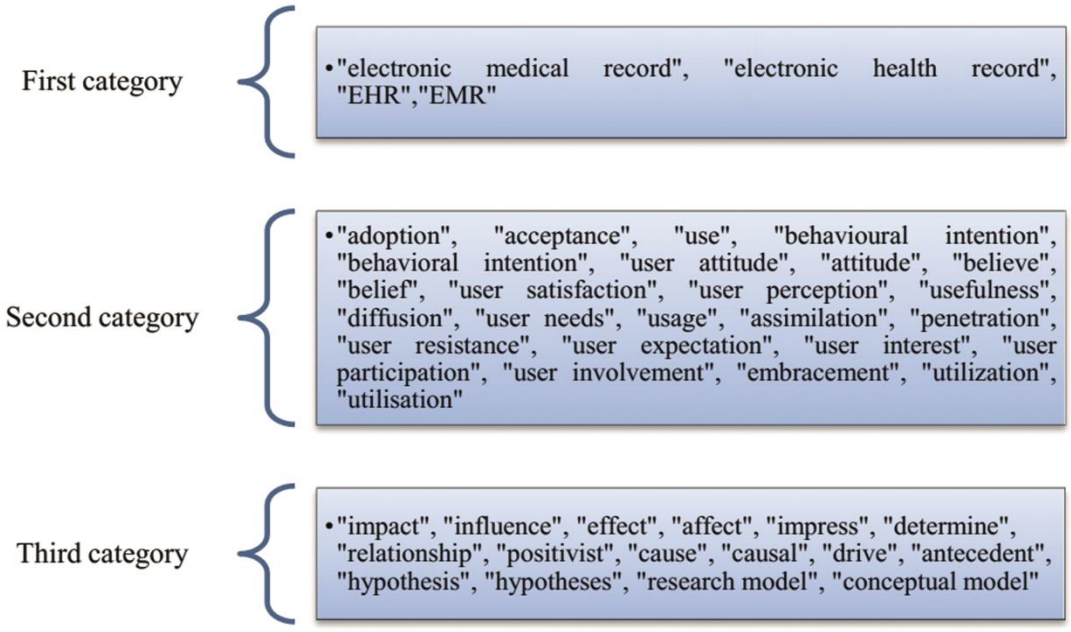

Figure 2.5 Three categories of search terms

The following selection criteria were used: (1) papers have been published before June 2013; (2) English-language articles; (3) papers focus on EMR or EHR, and not other computerized systems in healthcare such as Personal Health Record (PHR); and (4) papers focus on factors that affect adoption of EMR/EHR systems.

Figure 2.6 presents the stages of the study selection process used in this study. The first stage contained searching keyword terms (see the search terms section) on nine scientific databases (see the resources searched section). As a result, 9,684 primary articles were identified for initial screening. Subsequently, the researcher excluded articles on the basis of their titles (8,537 papers excluded; n=1,147). For example, in the Scopus database, the researcher used the Advanced Search Section of the website and inserted keywords and hit the search button. After that the researcher read all titles and downloaded the papers that are relevant to the study. Stage 3 involved exclusion of articles on the basis of their abstract (776 papers excluded; n=371). In this stage, the researcher read all the abstracts of the downloaded papers and kept all the relevant articles. At the final stage, duplicated articles were deleted and

read the full text (282 articles excluded; n=89). As a result of these steps, 89 relevant papers were achieved that focus on factors impacting on EMR adoption.

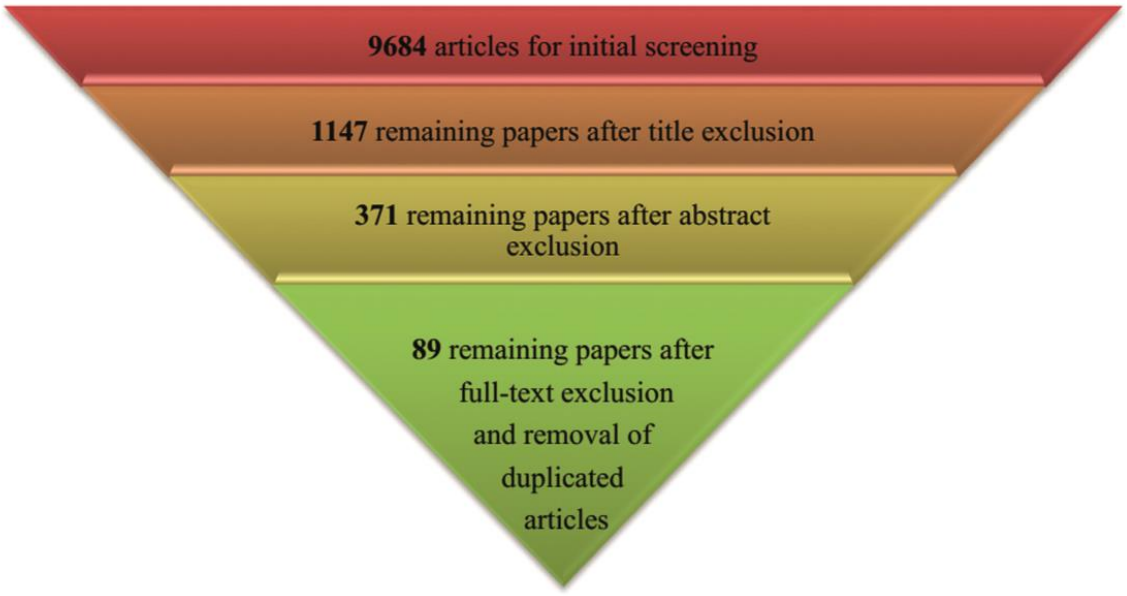

Figure 2.6 Stages of the study selection process to conduct systematic review

Table 2.3 shows the number of papers at each stage of the selection process. There were 9684 papers initially, and after title, abstract and full-paper exclusion, 89 papers remained.

In data analysis procedure, according to definitions and terminologies of the factors in literature, a list of 78 factors affecting EMR adoption was identified. In this process, some factors were merged based on the meaning and explanation of the factors in different articles. For instance, "system complexity" was one of the significant factors impacting on EMR adoption in Boonstra and his colleague's work (Albert Boonstra and Broekhuis 2010b).

Table 2.3 Number of papers in different stages of study selection process

Database	Initial number of papers	Remaining papers (title exclusion)	Remaining papers (abstract exclusion)	Remaining papers (full-paper exclusion and removing duplicated papers)
Science Direct	353	52	21	3
Scopus	3050	213	75	12
ProQuest	2281	238	64	11
PubMed	1382	297	92	28
IEEE Xplore	284	53	24	6
ACM Digital Library	57	10	4	0
Association for Information Systems electronic library	78	22	13	8
SpringerLink	297	35	16	0
ISI Web of Science	1902	227	62	21
Total	**9684**	**1147**	**371**	**89**

According to the definition they proposed for system complexity, "The complexity and usability problem associated with EMRs results in physicians having to allocate time and effort if they are to master them" ((Albert Boonstra and Broekhuis 2010b), page 8), this factor was merged with "ease of use", which has been used in EMR adoption studies. This analysing process decreased the list from 88 to 78 conceptually different factors.

In the next step, the researcher aimed to categorize the 78 factors into meaningful clusters in order to make a more comprehensive taxonomy. The researcher has applied the same approach which used by Amrollahi (2013). To do this, he went through the source of reviews in the EMR research and also different research areas in the EMR literature such as EMR system development, policy and standards, and medical research. An appropriate label to each factor based on its terminologies in the literature was assigned. For instance, psychological, organizational, financial, legal, and technical labels are based on Boonstra and his colleague

work' (2010b), while the individual label is based on Liu and her colleagues' work (2012). Finally, the idea of the environmental label is based on Ash and Bates' article (2005) and the behavioural label is adopted from Morton and her colleagues (2010).

After finished the labelling process, the researcher had four rounds to achieve a better classification of factors affecting EMR adoption. Some labels were revised with better terminology or merged in the third and fourth rounds to get the final classification. Finally, he identified the eight labels: individual; psychological; behavioural; environmental; organizational; financial; legal; and technical.

After that, a description of the 78 factors and sets of the eight labels were presented to three researchers in health informatics as a validation process. The researcher asked them to map the 78 factors against the eight categories proposed by the authors. As a matter of fact, 234 (78×3) possibilities were achieved from the three researchers. Finally, the researcher finalized all possibilities and made the final taxonomy of factors affecting EMR adoption (M. Najaftorkaman et al. 2013a).

2.3.2.2 Theoretical Perspectives in EMR Adoption Literature

As a part of the systematic review approach, the researcher found that 17 distinct theories and models as theoretical foundations on the EMR adoption studies (M. Najaftorkaman et al. 2013a). The researcher identified that many studies on EMR adoption have not used any theories to frame the research and elaborate their results. This shows the need to pay attention to theoretical support for the research and to increase the reliability of the results.

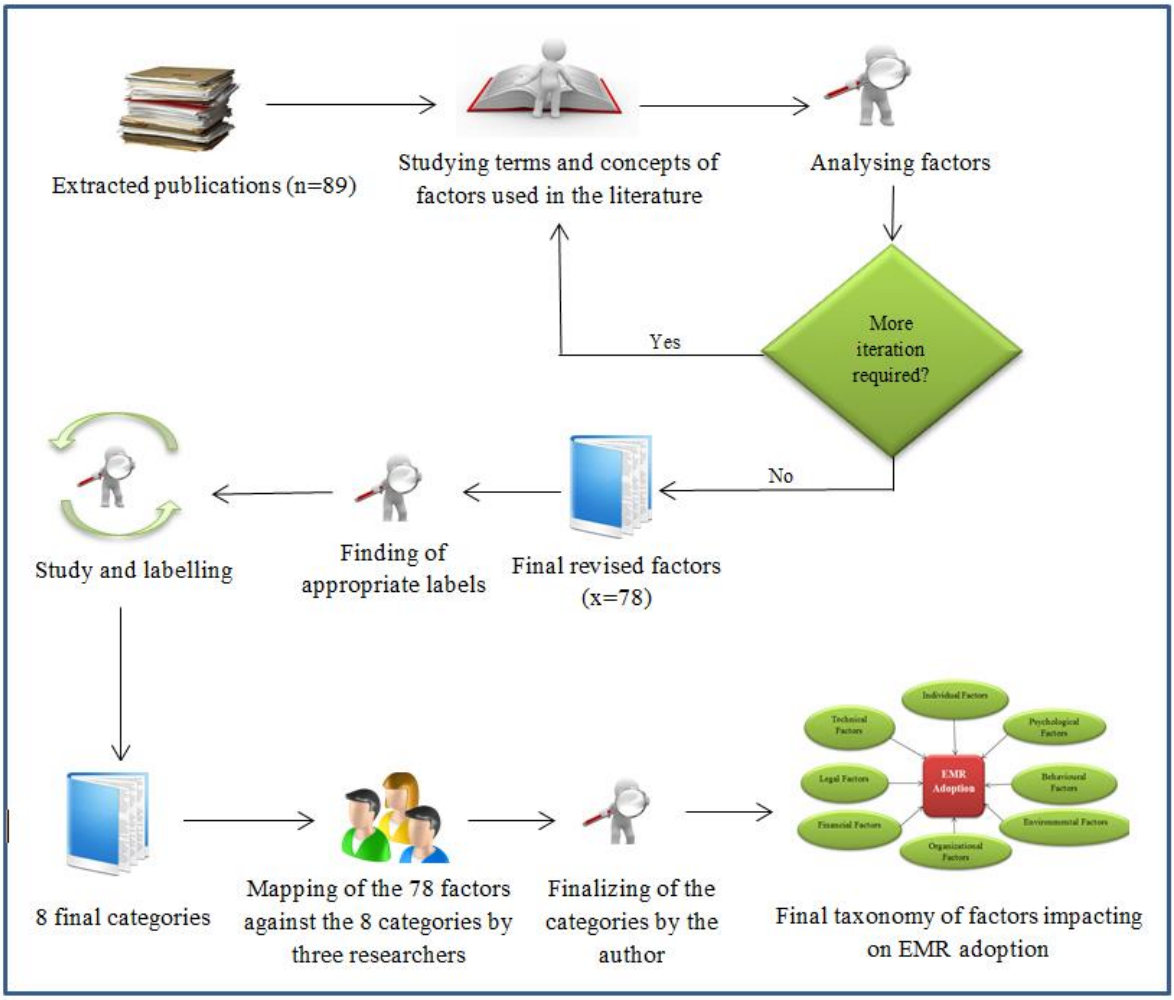

Figure 2.7 Data analyss process to conduct systematic review

The theories that have been used in EMR adoption research are the Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), Theory of Reasoned Action (TRA), Unified Theory of Acceptance and Use of Technology (UTAUT), Innovation Diffusion Theory (IDT), expectation confirmation theory, information system post-acceptance model, general systems theory, theory of interpersonal behaviour, human, organization and technology-fit model, resource dependence theory, social contagion theory, elaboration likelihood model, Nolan's Stages of Growth Model, institutional theory, resource-based view theory, and network effects theory (see Figure 2.7).

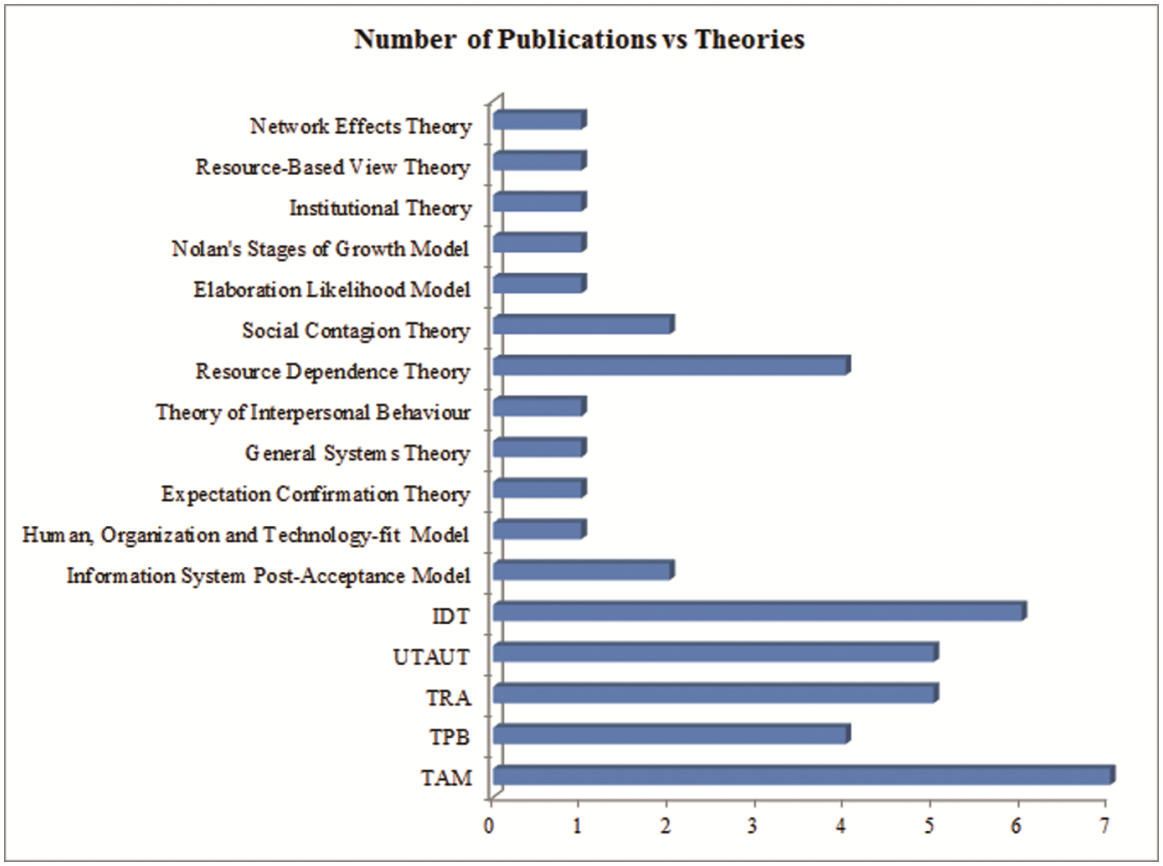

Figure 2.8 Distribution of papers over different theories

A total of 17 distinct theories were presented in the studies that applied theory. The maximum number of theories used within a single research paper was four (two studies); five studies cited two theories, but most studies applied only one theory. For example, Mettler (2012) explained the user continuance behaviour measures to use the EMR system. He applied four theories to support his research models, including the expectation confirmation theory, initial post-acceptance model of information system continuance, theory of planned behaviour, and theory of reasoned action. Furthermore, Hewitt (2009) used the technology acceptance model and innovation diffusion theory to support information security measures affecting the adoption of EHR systems. Table 2.4 provides a detailed list of all the theories and models used in the systematic review, the academic disciplines in which the theories are proposed and antecedents to EMR adoption based on each specific theory.

Table 2.4 List of theories used in EMR adoption research

Discipline	Theory	Antecedents to EMR adoption (based on the theory)
Information Systems	Technology acceptance model	Perceived usefulness, perceived ease of use, experience, subjective norms, computer self-efficacy, usability, job relevance
	Information system post-acceptance model	Expected benefits, emotions, Computer literacy, task fit, facilitating condition
	Unified theory of acceptance and use of technology	Performance expectancy, effort expectancy, social influence, facilitating conditions
	Human, organization and technology-fit model	organizational factors (structure), system quality, system use, user satisfaction
	Nolan's Stages of Growth Model (Stages of Growth Theory)	Organization features (size of practice)
Psychology	Theory of planned behaviour	Attitude toward the behaviour, subjective norm, perceived behavioural control (self-efficacy)
	Theory of reasoned action	Normative belief, motivation
	Theory of interpersonal behaviour	Personal normative belief (personal norm, self-identity, professional norm), social normative belief, perceived consequences, affect, facilitating condition
	Expectation confirmation theory	Confirmation, system expectation
Organization and Management Science	Resource dependence theory	Competition, environmental uncertainty, organizational factors (system, size, affiliation, ownership, financial resources)
	Social contagion theory	Self-efficacy, experience from co-workers, image(cues to action)
	Institutional theory	Competition

	Resource-based view (RBV) theory	Competition
	Network effects theory	Relationship between user
Multidisciplinary Science	Innovation diffusion theory (anthropology, sociology, rural sociology, education, industrial sociology, and medical sociology)	Motivation, image (cues to action)
	General systems theory (management, philosophy of science, physics, computer science, biology, engineering, geography, sociology, political science, and psychotherapy)	Communication tools, communication mechanisms, level of physician involvement, cultural change, facilitating a learning environment
	Elaboration likelihood model (Information science and management)	Prior Knowledge, experience, privacy

The theories used in the EMR adoption studies are from four main disciplines, namely: Information Systems, Psychology, Organization and Management Science, and Multidisciplinary Science. As Figure 2.8 presents, the most commonly used theories are related to information systems disciplines. From the four theories in the information systems category (TAM, information system post-acceptance model, UTAUT, human, organization and technology-fit model, and Nolan's Stages of Growth Model), there are some antecedents to the EMR adoption such as perceived usefulness, perceived ease of use, experience, subjective norms, self-efficacy, usability, emotions, computer literacy, facilitating conditions,

performance expectancy, effort expectancy, social influence, system quality, system use, and user satisfaction.

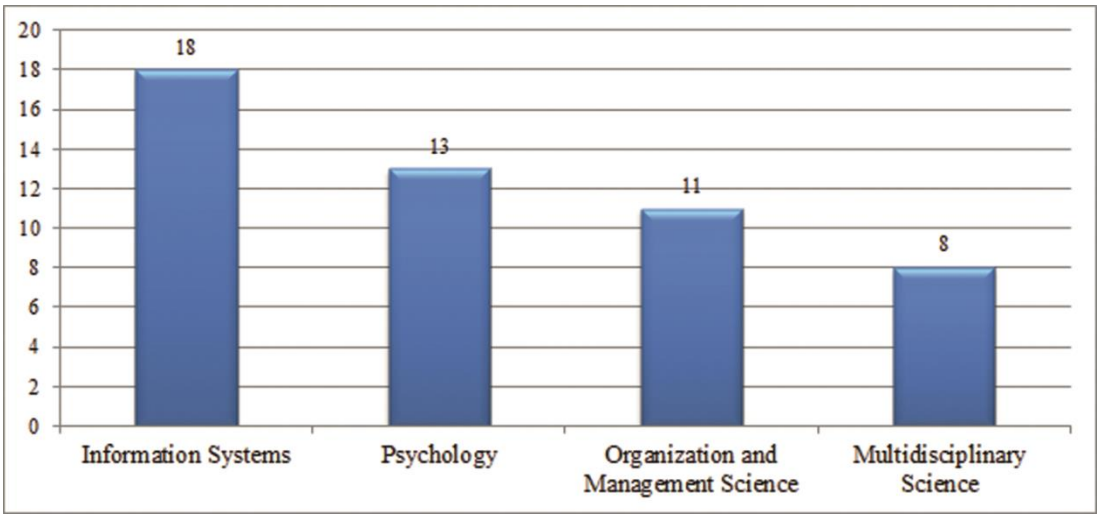

Figure 2.9 Main theory disciplines in EMR adoption

Furthermore, 13 studies have used theories from psychology discipline, including theory of planned behaviour, theory of reasoned action, theory of interpersonal behaviour, and expectation confirmation theory. There are various variables that have direct and indirect impact on EMR adoption based on psychological theories such as attitude toward behaviour, subjective norm, perceived behavioural control (self-efficacy), normative belief, motivation, self-identity, professional norm, social normative belief, perceived consequences, affect, facilitating conditions, confirmation, and system expectation. For example, Gagnon and colleagues (2010) stated that intention to use, facilitating conditions, and habit are three direct determinants that influence behaviour that derived from the theory of interpersonal behaviour.

Additionally, 11 studies used organization and management science theories (resource dependence theory, social contagion theory, institutional theory, resource-based view theory, and network effects theory). For instance, Kazley and Ozcan (2007) used resource dependency

theory to assess environmental and organizational factors impacting on EMR adoption. They proved that hospitals with high percentage of public reimbursement and with greater financial resources are more likely to adopt EMR systems. They identified antecedents to EMR adoption based on resource dependency theory such as competition, rurality, munificence, uncertainty, size of organization, system affiliation, ownership, medicare payer mix, financial resources, and teaching status. Moreover, Zheng and colleagues (2010) applied social contagion theory to find out how social interactions impact on physicians' adoption of EMR systems. Based on this study, professional network such as the doctor-patient relationship, friendship networks based on personal intimacy, and a person's perception of how other EMR users have affected his/her intention to accept the systems are the most important antecedents to EMR adoption through the lens of social influence.

Finally, there are eight studies that have used multidisciplinary science theories. For instance, Hewitt (2009) used IDT theory to develop his model. He showed how users integrate EMR systems into their healthcare environment by exploring how diffusion is influenced by social health systems, communication techniques, interaction over time and innovation. He identified observability, triability and compatibility as the most important antecedents to attitude toward using EMR systems. Moreover, Nambisan and colleagues (2013) claimed that general system theory provides useful conceptions for evaluating environmental, organizational and individual factors impacting on EMR adoption. General system theory looks at the EMR systems as a whole instead of emphasising individual parts. This concept comes from different fields of science such as philosophy, physics, computer science, biology, engineering, geography, sociology, political science, and psychotherapy.

2.3.2.3 Taxonomy of Antecedents to EMR Adoption in the Literature

After identifying the theories that have been used to clarify the adoption of EMR systems, the researcher looked for the antecedents to EMR adoption (M. Najaftorkaman et al. 2013a). This systematic review identified 78 factors that affected the adoption of EMR systems (see Figure 2.9). In this part, the researcher provides a table for each category that contains the name of factors, sample conclusion, related references, theories that justify each factor, positive, negative, and non-significant. Under the positive column, the researcher mentions the number of references in which a positive relationship between the independent factor and EMR adoption has been stated. Under the negative column, the number of references in which a negative relationship between the independent factor and EMR adoption has been defined are indicated. Under the non-significant column, the researcher mentions the number of references in which a relationship between the independent factor and EMR adoption has not been found to be significant.

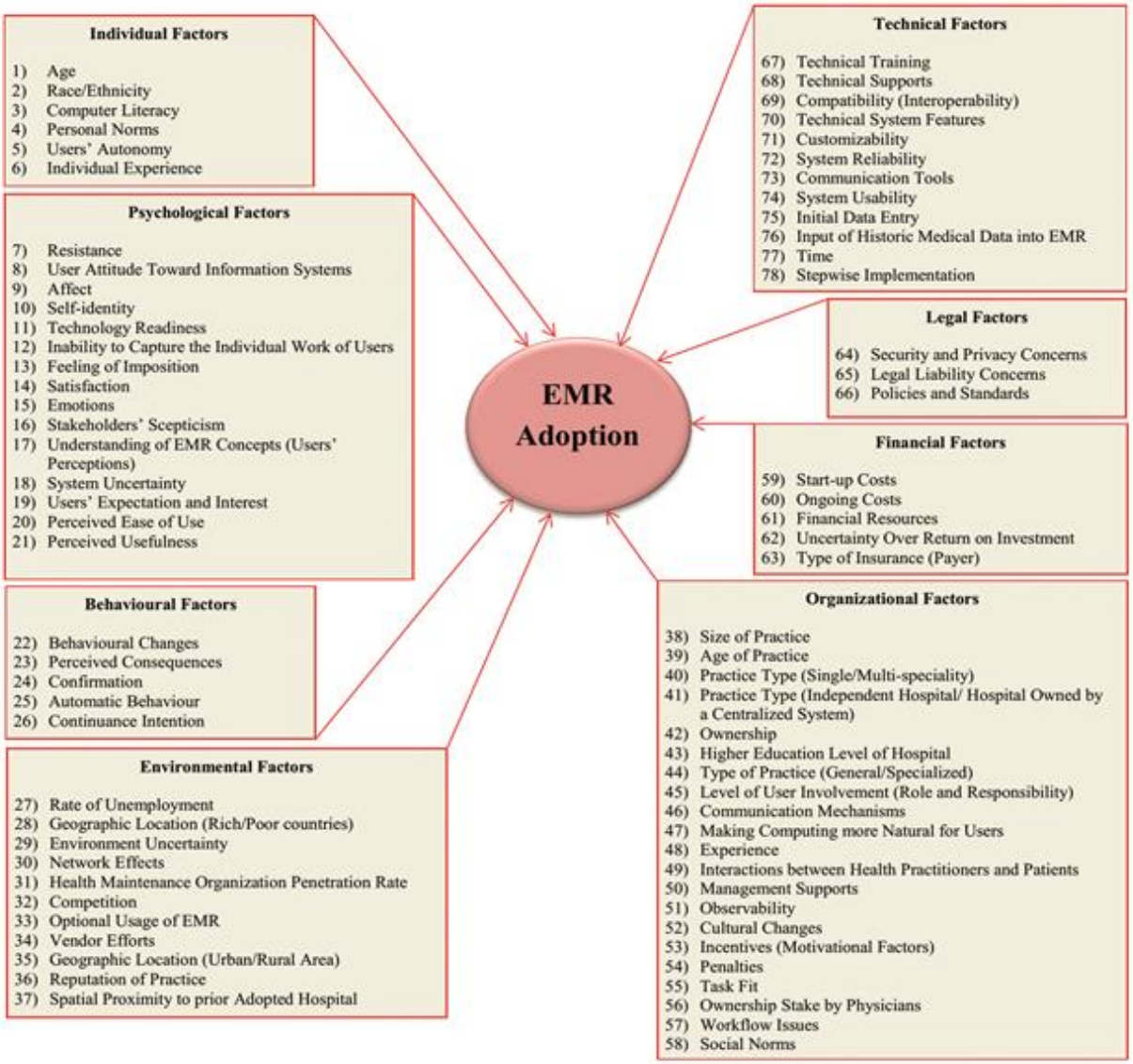

Figure 2.10 The taxonomy of factors impacting EMR adoption

2.3.2.3.1 Individual Factors

Individual factors clarify individual attributes that consist of six factors: age, race/ethnicity, computer literacy, personal norms, users' autonomy, and individual experience. The level of an individual's computer literacy is very important for users in adopting EMR systems. Some EMR users are not confident about using the software and hardware of a computer (Simon et al. 2007; Terry et al. 2009). In addition, user autonomy is one of the key individual factors that

have an impact on EMR adoption. For instance, physicians would like to have the freedom to carry out appropriate treatments for their patients based on their best judgment. Unfortunately, there is a strong negative relationship between physicians' autonomy and EMR behavioural use. Physicians' autonomy is one of the biggest concerns with regard to adopting EMR systems in the healthcare environment (Morton and Wiedenbeck 2009).

Table 2.5 presents a list of the individual factors reported in this study. The results reveal that individual factors that have an impact on EMR adoption have been theorized by TAM, TRA, TPB, IDT, the theory of interpersonal behaviour, and social contagion theory. However, this study finds that the race/ethnicity factor has not been justified by any theory in the papers. Our review shows that although EMR systems have the potential to assist older users, seniors generally have more trouble in adopting EMR systems than younger ones. Furthermore, the researcher propose that computer literacy affects EMR adoption, although the direction of the effect is debatable in the EMR adoption literature. Although Mettler (2012) argued that computer literacy has no significant impact on automatic EMR use behaviour, it has been shown in the literature that computer literacy has a positive impact on EMR adoption and users with more computer skills are more likely to adopt the systems (Stream 2009; Terry et al. 2009).

2.3.2.3.2 Psychological Factors

The second category, psychological factors, is composed of 15 factors: resistance, user attitude towards information systems, affect, self-identity, technology readiness, inability to capture the individual work of users (emotional feeling), feeling of imposition, satisfaction, emotions, stakeholders' scepticism, understanding of EMR concepts (users' perceptions), system uncertainty, users' expectation and interest, perceived ease of use, and perceived usefulness. It focuses on factors impacting on the emotional feelings of EMR users.

For example, perceived ease of use and perceived usefulness are the two most significant indicators that impact on the individual use of EMR systems. Perceived ease of use or the level of complexity of the systems is defined as an individual belief about using a particular system without great effort.

Vathanophas and Pacharapha (2010) showed that healthcare providers' perceived ease of use positively affects intention to use EMR systems. In addition, perceived usefulness is defined as an individual belief about using a particular system that can help him or her to improve performance. A perceived usefulness or perceived benefit is found to be a key psychological factor influencing EMR adoption (Morton and Wiedenbeck 2010; Nov and Schecter 2012; Vathanophas and Pacharapha 2010).

Table 2.6 shows the list of psychological factors derived from the literature. It has been shown in the EMR adoption literature that if users believe that using EMR systems can help them to handle their tasks and can also be effortless, the EMR adoption rate is significantly increased. Thus, perceived ease of use and perceived usefulness are the facilitators to the adoption of EMR systems and they are explained by the adoption theories such as TAM, TRA, IDT, TPB, and UTAUT.

Table 2.5 Individual factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Age	"… younger physicians believe there is more support available for the use of an EHR system compared with the other age groups …" ((Wright and Marvel 2012), page 265)	(Abdolrasulnia et al. 2008; Hewitt 2009; Jialin Liu 2012; C. Li and West-Strum 2010; Linder et al. 2006; Venkatesh et al. 2011; Wright and Marvel 2012)	TAM IDT UTAUT		5	2
Race/Ethnicity	"Using combinations of race/ethnicity and insurance coverage revealed that as the proportions of Hispanic patients with other insurance or non-Hispanic black patients who self-paid or received charity care/no charge increase the likelihood of adopting EMRs with ''comprehensive'' ((C. Li and West-Strum 2010), page 977)	(Jialin Liu 2012; C. Li and West-Strum 2010)	n/a		2	
Computer Literacy	"… it is assumed that users with low levels of computer literacy are more likely to invest cognitive resources toward performing a task. In other words, low computer literacy on the side of the EMR user will lead to more automatic behaviour..." ((Mettler 2012), page 5)	(Albert Boonstra and Broekhuis 2010b; Cotea 2010; Ford 2009; Hier et al. 2005; Jha et al. 2009; Kemper et al. 2006; Mettler 2012; Ochieng and Hosoi 2006; Shaw and Manwani 2011; Simon et al. 2007; Stream 2009; Terry et al. 2009; Tiankai Wang and Biedermann 2012)	IDT TRA TAM	10	1	2
Personal Norms	"…described as the feeling of personal obligation regarding the performance of a given behaviour, and self-identity, which refers to the degree of congruence between the individual's perception of self and the characteristics he or she associates with the realisation of the behaviour..." ((Gagnon et al. 2010), page 5)	(Gagnon et al. 2010; Nov and Schecter 2012)	Theory of interpersonal behaviour	2		
Users' Autonomy	"There was a strong negative direct relationship between autonomy and attitude about EHR use. This relationship was not ..." ((Morton and Wiedenbeck 2009),page 5).	(Albert Boonstra and Broekhuis 2010b; Morton and Wiedenbeck 2009, 2010)	IDT		3	
Individual Experience	This factor focuses on previous experiences of EMR users. Studies show that previous experience has direct impact on EMR adoption.	(Cotea 2010; Kemper et al. 2006; Vishwanath and Scamurra 2007; Zheng et al. 2010)	Social contagion theory	4		

2.3.2.3.3 Behavioural Factors

As the name suggests, behavioural factors impact on EMR users' behaviours in accepting or rejecting EMR systems. They contain five factors: behavioural changes, perceived consequences, confirmation, automatic behaviour, and continuance intention. For instance, Mettler (2012) revealed that automatic behaviour or habit can facilitate EMR adoption. There are some factors, including computer literacy, task fit and facilitating conditions, that impact on automatic behaviour. Although task fit and facilitating conditions positively influence the development of automatic behaviour, computer literacy has a negative impact on an individual's continuance behaviour.

Table 2.7 provides a list of behavioural factors that have been reported as having a significant impact on EMR adoption. It has been presented in the EMR adoption literature (Tang et al. 2006a), but not clarified by the adoption theories, that one of the behavioural barriers to the adoption of EMR systems is behavioural changes.

On the other hand, the other behavioural factors have been well addressed by adoption theories such as TRA, TPB, and the theory of interpersonal behaviour. Additionally, according to interpersonal behaviour theory, perceived consequences refer to cognitive assessment of the possible consequences of behaviour. Perceived consequences of using EMR systems have a significant impact on EMR adoption. If users know about various benefits and consequences of using EMR systems they can adopt EMR systems faster.

Table 2.6 Psychological factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Resistance	"…patients will be opposed to their use of the EHR. Some HPs have also expressed concerns about EHRs affecting their communication with patients such as loss of eye contact, which is against the social norm for physicians to avoid using the computer while with the patient. ((Cotea 2010),page 12)	(Albert Boonstra and Broekhuis 2010b; Cotea 2010; Holden 2011; Kemper et al. 2006; A. Lee 2011; Nov and Schecter 2012; Rao et al. 2011; Scholl et al. 2011; Sibona et al. 2010; Yoon et al. 2012)	IDT		10	
User Attitude Toward Information Systems	"We have defined user attitude towards information systems to characterize a subjective critical adoption factor of the electronic health records…" ((Castillo et al. 2010), page 5)	(Castillo et al. 2010)	n/a	1		
Affect	"Affect represents an emotional state that the performance of a given behaviour evokes for an individual." ((Gagnon et al. 2010), page 5). This study proves that affect impacts on intention to use which has direct impact on EMR adoption.	(Gagnon et al. 2010)	Theory of interpersonal behaviour	1		
Self-identity	"Self-identity refers to the degree of congruence between the individual's perception of self and the characteristics he or she associates with the realisation of the behaviour." ((Gagnon et al. 2010), page 5). They proved that self- identity impacts on intention to use of EMR system.	(Gagnon et al. 2010)	Theory of interpersonal behaviour	1		
Technology Readiness	"…technology readiness by physicians was found to be the strongest predictor of EHR adoption regardless of market forces or practice level factors. …" ((Abdolrasulnia et al. 2008), page 249]	(Abdolrasulnia et al. 2008; Albert Boonstra and Broekhuis 2010b; Cotea 2010; Marques et al. 2011)	n/a	4		
Inability to Capture the Individual Work of Users	"the EHRS does not capture these intangible aspects of nursing.", "nurses fear that the EHRS will take time away from actually caring for the patient and make the art of nursing impersonal." ((Sassen 2009), page 282)	(Sassen 2009)	n/a		1	

Table 2.6 Psychological factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Feeling of Imposition	"79% of the doctors and midwives surveyed in their study stated that it was important for them to have a choice about using the EHRS. Moreover, 30% said they would refuse to use it without a demonstration of benefits even if using it was part of their contract." ((Sassen 2009), page 283)	(Sassen 2009)	n/a		1	
Satisfaction	"satisfaction is a key determinant of continuance and can be described as function of prior expectations and post adoption performance perception and confirmation/disconfirmation" ((Mettler 2012), page1). They proved that satisfaction has direct impact on EMR continuance intention.	(Mettler 2012; Wright and Marvel 2012)	TAM	2		
Emotions	"Positive/negative emotions such as anger, fear, envy, sympathy, and pleasure impact on EMR continuance behavior…" ((Mettler 2012), page 4)	(Mettler 2012)	n/a	1		
Stakeholders' Scepticism	One of the main important EMR barriers is Physician scepticism. They do not believe EMR system is useful compare to the paper-based methods (Stream 2009).	(Haughom et al. 2011; Jha et al. 2009; Simon et al. 2007; Stream 2009)	n/a		4	
Understanding of EMR Concepts (Users' Perceptions)	"the lack of ease of use and usefulness are control issues creating negative perceptions about EHRs, which in-turn exacerbate the physician's concerns or anxiety about adopting the new technology." ((Vishwanath and Scamurra 2007), page 131). This factor focuses on understanding of EMR capabilities by stakeholders.	(Cotea 2010; Hier et al. 2005; Holden 2011; Likourezos et al. 2004; Noteboom et al. 2012; Sibona et al. 2010; Vishwanath and Scamurra 2007; Tiankai Wang and Biedermann 2012)	TAM UTAUT IDT	8		
System Uncertainty	This factor is related to users' concerns about EMR system become obsolete after adopt it (Rao et al. 2011).	(Rao et al. 2011)	n/a		1	

Table 2.6 Psychological factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Users' Expectation and Interest	"A picture of the overall expectations and interests that can affect the adoption of EMR systems at large hospitals in a developing country, and ways to help meet these expectations, could thus be of value, as it is unclear as to how complex of an environment can be expected and how to approach the adoption of system for this unknown complexity." ((Scholl et al. 2011), page 959)	(Otto and Nevo 2013; Scholl et al. 2011)	TRA	2		
Perceived Ease of Use	"Perceived ease of use was in turn defined as the degree to which a person believes that using a particular system would be free of effort" ((Vathanophas and Pacharapha 2010), page 1). It has direct impact on intention to use and EMR adoption. "Healthcare professions' perceived ease of use positively affects intention to use EMR." ((Vathanophas and Pacharapha 2010), page 4).	(Andrew Schwarz 2011; Norm Archer and Cocosila 2011; Albert Boonstra and Broekhuis 2010b; Davidson and Heslinga 2006; Heselmans et al. 2012; Hewitt 2009; Marques et al. 2011; Morton and Wiedenbeck 2009, 2010; Nov and Schecter 2012; Vathanophas and Pacharapha 2010; Tiankai Wang and Biedermann 2012; Wilkins 2009; Wright and Marvel 2012)	TAM, TRA,IDT,TPB, UTAUT	14		
Perceived Usefulness	"Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance"." ((Vathanophas and Pacharapha 2010), page 1). "Healthcare professions' perceived usefulness positively affects intention to use EMR." ((Vathanophas and Pacharapha 2010), page 4).	(Carayon et al. 2011; Hewitt 2009; Holtz and Krein 2011; Kok et al. 2011; Morton and Wiedenbeck 2009, 2010; Nov and Schecter 2012; Sibona et al. 2010; Vathanophas and Pacharapha 2010; Venkatesh et al. 2011; Vishwanath and Scamurra 2007; Wilkins 2009)	TAM	12		

2.3.2.3.4 Environmental Factors

Environmental category is composed of 11 factors: rate of unemployment, geographic location (rich/poor countries), environment uncertainty, network effects, health maintenance organization (HMO) penetration rate, competition, optional usage of EMR, vendor efforts, geographic location (urban/rural areas), reputation of practice, and social proximity to prior adopted hospital.

For instance, membership or social proximity in a health system as a same social group is a very important factor in facilitating EMR adoption. Information exchanges during formal and informal communication in the same social system impact on individuals' behaviours. Furthermore, if the hospitals are members of the same health system, they can rapidly adopt a new technology. Therefore, a hospital within a focal health system is more eager to adopt EMR systems than a hospital outside the focal health system (Angst et al. 2010). Furthermore, the rural hospitals face some difficulties such as a lower rate of occupancy and support, and more financial and social pressures. In general, the rural hospitals may be the only option for local people, so they do not try to compete with other hospitals to adopt new technology. Consequently, the urban hospitals are more likely to adopt EMR systems than the rural hospitals (Kazley and Ozcan 2007). Additionally, network externalities or network effects play a significant role in EMR adoption. Network effects are defined as "increased utility for users of a technology that occurs when adoption increases among other users" ((Ayers et al. 2009), page 127). The current level of EMR acceptance among physicians can impact on new physicians in adopting EMR systems.

Table 2.7 Behavioural factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Behavioural Changes	"Behavioral change is difficult … change management issues involve providers, consumers, and regulators. First, there must be a motivation to change. While it is intuitive that PHRs can help to improve health by offering additional information when it is needed, better objective evidence of efficiency and effectiveness of PHRs may be required before consumers, providers, and regulators will move toward the goal of PHR adoption." ((Tang et al. 2006a), page 125)	(Tang et al. 2006a)	n/a		1	
Perceived Consequences	"perceived consequences refer to the cognitive evaluation of the probable consequences of the behaviour." ((Gagnon et al. 2010), page 5). This study shows that perceived consequences impacts on intention to use which has direct impact on EMR adoption.	(Gagnon et al. 2010)	Theory of interpersonal behaviour TAM	1		
Confirmation	"The greater the confirmation, the more satisfied users are (H2). Since users supposed to be rational, a satisfied EMR user might intend to continue its usage (H3)."((Mettler 2012), page 3). "It assumed that high rates of confirmation positively affects satisfaction, which in turn influences the intention to continue using and/or purchasing a particular product or service" ((Mettler 2012), page 2)	(Mettler 2012)	TRA TBP	1		
Automatic Behaviour	"The results from a longitudinal field study showed that automatic behavior, enabled by sufficient facilitating conditions ….. considerably affected healthcare professionals EMR continuance behavior." ((Mettler 2012), page 1)	(Mettler 2012)	TRA TBP	2		
Continuance Intention	"… EMR continuance intention will positively influence EMR continuance behaviour (HABIT)." ((Mettler 2012), page 3). It is clear that continuance behaviour has direct impact on EMR adoption.	(Mettler 2012)	TRA TBP	1		

Table 2.8 depicts sample conclusions for each environmental factor that impact on EMR adoption. This review has revealed that the role of environmental factors in EMR adoption has been theorized by resource dependence theory, network effects theory, institutional theory, resource-based view theory, general system theory, and social contagion theory. However, there are some factors that current theories cannot justify such as rate of unemployment, environment uncertainty, and optional usage of EMR.

For example, e-health researchers examining the influences of vendor efforts have argued for relationships with EMR adoption. Drawing on the broader e-health literature, the researcher argue that the vendor effort factor has a positive impact on EMR adoption through the desire to accept EMR systems. For instance, the researcher has found that vendors' and providers' efforts have a positive relationship with satisfaction with the system (Albert Boonstra and Broekhuis 2010b) because the quality of service from the vendors of EMR systems can encourage physicians to accept EMR. Furthermore, based on institutional theory, resource-based view theory, and resource dependence theory, the researcher expected competition to have a positive impact on EMR adoption. Competition can put pressure on health organizations to improve their health systems and therefore increase their productivity (Holden 2011).

2.3.2.3.5 Organizational Factors

Organizational factors describe healthcare practice characteristics, which are divided into 21 factors: size of practice, age of practice, practice type (single/multi-speciality), practice type (independent hospital/ hospital owned by a centralized system), ownership, higher education level of hospital, type of practice (general/specialized), level of user involvement (role and responsibility), communication mechanisms, making computing more natural for users, experience, interactions between health practitioners and patients, management supports, observability, cultural changes, incentives (motivational factors), penalties, task fit, ownership

stake by physicians, workflow issues, and social norms. For instance, Health Information Managers (HIMs) play a vital role in EMR implementation and adoption. HIM involvement in EMR system implementation can be participating in document improvement programmes, testing the legal admissibility of records, participating in the development of EMR functionality, and managing access control in an EMR system.

If health managers support an EMR system by providing workshop and training sessions within the health organization, they can promote EMR dissemination (Fenton et al. 2006; Wilkins 2009). Furthermore, communication between EMR users is very important for disseminating EMR certainty and co-workers can share their experience using the EMR system. For example, more experienced EMR users can provide support for less experienced users in applying EMR systems (Castillo et al. 2010).

Table 2.9 presents a list of organizational antecedents that have been reported in this research study. Our findings confirm the relationship between management supports and EMR Adoption. Based on Nolan's Stages of Growth Model and UTAUT, management support has a significant positive impact on successful adoption in health organizations and it can affect individuals' intention to adopt EMR systems. Likewise, based on social contagion theory, and Nolan's Stages of Growth Model, the researcher argued that size of practice is positively related to EMR adoption because larger health organizations may have more human and financial resources, so larger organizations are more likely to adopt new technology. However, there are some studies that have claimed that there is no relationship between size of practice and EMR adoption (Angst et al. 2010; Ayers et al. 2009; Jha et al. 2009).

Table 2.8 Environmental factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Rate of Unemployment	The rate of unemployment in the society impacts on EMR adoption. By reducing rate of unemployment, the rate of EMR acceptance is increased (Ford 2012b).	(Ford 2012b)	n/a		1	
Geographic Location (Rich/Poor countries)	People who live in rich country accept EMR system more easily compare to users living in poor country(Abdolrasulnia et al. 2008). "According to this study hospitals from poor countries, with poor technology readiness and lower education levels are less likely to adopt the system ….." ((Marques et al. 2011), page 97)	(Abdolrasulnia et al. 2008; Ford 2009, 2012b; Marques et al. 2011; Menachemi et al. 2012)	Resource dependence theory	3		2
Environment Uncertainty	For example, "The public payer sector has experienced the greatest amount of environmental uncertainty in recent years" because Medicare and Medicaid often reimburse hospitals at prices below the cost of providing services" ((Kazley and Ozcan 2007), page 377)	(Kazley and Ozcan 2007)	n/a		1	
Network Effects	"… defined as increased utility for users of a technology that occurs when adoption increases among other users", "each one unit increase in market-level EMR adoption is associated with a significant increase in overall physician adoption intention in that market. …. adoption of EMRs by specialists is significantly predictive of generalists' adoption intentions in a given market." ((Ayers et al. 2009), page 4)	(Ayers et al. 2009; Rahman and Ko 2012)	Network effects theory	2		
Health Maintenance Organization (HMO) Penetration Rate	"Physicians located in counties with higher HMO penetration rates are more likely to adopt EHR than physicians located in counties with lower HMO penetration rates, all other things remaining equal." ((Abdolrasulnia et al. 2008), page 244)	(Abdolrasulnia et al. 2008; Ford 2009, 2012b; C. Li and West-Strum 2010; Menachemi et al. 2012)	Resource dependence theory	4		1

Table 2.8 Environmental factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Competition	"Physicians located in counties with high ratios of physicians per capita (indicating high competition) are more likely to adopt EHR than physicians located in counties with fewer physicians per capita, all other things remaining equal." ((Abdolrasulnia et al. 2008), page 244)	(Abdolrasulnia et al. 2008; Ford 2012b; Holden 2011; A. Lee 2011; Tang et al. 2006a; Vathanophas and Pacharapha 2010; Venkatesh et al. 2011) (Menachemi et al. 2012)	Institutional theory Resource-based view (RBV) theory Resource dependence theory	7		1
Optional Usage of EMR	"use of electronic records during clinical consultation completely optional for the health staff. They could choose to use the system, or if they felt uncomfortable with it, they can work with a paper print out of the electronic record of a patient." ((Scholl et al. 2011), page 265)	(Scholl et al. 2011)	n/a	1		
Vendor Efforts	"the quality of vendors and marketers of EMR systems is crucial for the acceptance of EMRs." ((Albert Boonstra and Broekhuis 2010b), page 10)	(Andrew Schwarz 2011; Albert Boonstra and Broekhuis 2010b; Gagnon et al. 2009; Kemper et al. 2006; Nambisan et al. 2013; Sibona et al. 2010)	General system theory	6		

Table 2.8 Environmental factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Geographic Location (Urban/Rural Areas)	It is related to urban/rural areas. People who live in urban areas adopt EMR system more than people who live in rural areas(Kazley and Ozcan 2007).	(Chae et al. 2011; Cotea 2010; Ford 2009, 2012b, 2012a; Jha et al. 2009; Kazley and Ozcan 2007; C. Li and West-Strum 2010; Menachemi et al. 2007; Menachemi et al. 2012; Rao et al. 2011; Teufel II et al. 2013)	Resource dependence theory	8		4
Reputation of Practice	"As a current nonadopter hospital scans its environment and seeks to establish legitimacy by emulating prestigious role models, we expect that EMR adoption by celebrity hospitals will exert a relatively more potent social influence.", "Within the population of adopters, the infectiousness of celebrity adopter hospitals is stronger than the infectiousness of noncelebrity adopter hospitals." ((Angst et al. 2010), page 1226)	(Angst et al. 2010; Linder et al. 2006; Rahman and Ko 2012; Singh et al. 2012)	Social contagion theory	3		1
Social Proximity to prior Adopted Hospital (Membership to Social Network)	"Social proximity or membership in a social group is also important for contagious influence.", "Adoption by a hospital within the focal hospital's health system (in-system) is more positively associated with likelihood of adoption than adoption by a hospital outside the focal hospital's health system" ((Angst et al. 2010), page 1227-1226)	(Angst et al. 2010; Vishwanath and Scamurra 2007; Zheng et al. 2010)	Social contagion theory	3		

2.3.2.3.6 Financial Factors

The next category, financial factors, is composed of five factors: start-up costs, ongoing costs, financial resources, return on investment (ROI), and type of insurance. For example, Menachemi and colleagues (2007) evaluated the role of payer mix on physicians' decisions to adopt EHR systems. Their findings show that if the percentage of people covered by Medicaid raises, the likelihood of EHR acceptance decreases. Furthermore, patients in the high-volume payers group such as managed-care payers and traditional indemnity insurers are more likely to adopt EHR systems than the low-volume group. In addition, Simon and colleagues (2007) revealed that a majority of health providers pointed to financial factors, including start-up costs, ongoing costs, or other financial issues such as financial constraints, and concern about return of investment, as important barriers to EMR adoption.

Based on Table 2.10 shows that the ongoing costs that are related to administration, control, implementation, upgrading of EMR systems and type of insurance in the healthcare industry are the major barriers to EMR adoption. Furthermore, the researcher showed that uncertainty over return on investment is negatively related to EMR adoption because EMR providers are doubtful about applying new technology in their workplaces (Gagnon et al. 2009). Finally, types of insurance (payer mix) can impact on EMR adoption and these reimbursement issues are different from one payer to another (e.g., Medicare, Medicaid, and private payers). For example, Menachemi and colleagues (2007) claimed that if the percentage of patients covered by private payers increases, the likelihood of EMR adoption increases. However, as Medicaid patients increase as a proportion of all patients in healthcare, the likelihood of EMR adoption will decrease. Moreover, the percentage of patients covered by Medicare does not have a significant influence on EMR adoption.

Table 2.9 Organizational factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Size of Practice	"Organizational Power is often associated with size since larger organizations may have more financial and human resources with which to attain necessary inputs from the environment… larger hospitals are more likely to adopt EMRs." ((Kazley and Ozcan 2007), page 378)	(Abdolrasulnia et al. 2008; Angst et al. 2010; Avgar et al. 2010; Albert Boonstra and Broekhuis 2010b; Chae et al. 2011; Ford 2009, 2012a; Ginn et al. 2011; Jha et al. 2009; Kazley and Ozcan 2007; P. Li et al. 2008; Marques et al. 2011; Menachemi et al. 2007; Rahman and Ko 2012; Sassen 2009)	Social contagion theory Nolan's Stages of Growth Model	12		3
Age of Practice	"Older nonadopter hospitals are more susceptible to the contagious influence of prior adopters than are younger nonadopter hospitals." ((Angst et al. 2010), page 1225)	(Angst et al. 2010; Binti Ismail and Binti Abdullah 2011)	Social contagion theory	1		1
Practice Type (Single/Multi-Speciality)	Multi-speciality hospitals adopt EMR system more easily compare to the single speciality hospitals (Menachemi et al. 2007).	(Jha et al. 2009; C. Li and West-Strum 2010; Menachemi et al. 2007; Menachemi et al. 2012; Rao et al. 2011)	Resource dependence theory	3		2
Practice type (Independent Hospital/ Hospital Owned by a Centralized System)	"After adjusting for the number of operating rooms, the number of emergency room visits, and the number of hospital total full-time equivalent staff, small hospitals owned by multihospital systems were associated with 0.25 higher mean EMR adoption level ($p < .05$) than independent hospitals and no significant relationship was observed for hospitals that were leased/managed by a system..." ((P. Li et al. 2008), page 169)	(Bramble et al. 2010; Cotea 2010; Ford 2012a; Kazley and Ozcan 2007; P. Li et al. 2008; Ludwick and Doucette 2009)	Resource dependence theory	6		

Table 2.9 Organizational factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Ownership	The rate of EMR adoption varies between public, investor owned, and teaching hospitals.For example, "Teaching hospitals provide a great deal of charity care and medical research, as well as provide the training and educations of many of the nation‟s health care workforce. …. Teaching hospitals are more likely to adopt MRS;"((Marques et al. 2011), page 91)	(Chae et al. 2011; Ginn et al. 2011; Kazley and Ozcan 2007; Marques et al. 2011; Simon et al. 2009; Teufel II et al. 2013)	n/a	3		3
Higher Education Level of Hospital	"… Medical record system implementation requires employees with higher education level….Hospitals with higher education levels are more likely to adopt MRS; "((Marques et al. 2011), page 91)	(Marques et al. 2011)	n/a	1		
Type of Practice (General/Specialized)	"General hospitals often report higher occupancy rates and more financial and social pressures. A specialized hospital is only option for a specific target, thus not requiring the hospital to compete with others in the environment general hospital would be more likely to take actions, such as MRS adoption to attract patients."((Marques et al. 2011), page 92)	(Marques et al. 2011)	n/a	1		
Level of User Involvement (Role and Responsibility)	"The level of physician involvement at the grassroots level in the initial adoption process will be positively related to the overall adoption and sustained use of EMRs by physicians."((Nambisan et al. 2013), page 4)	(Avgar et al. 2010; Jensen and Aanestad 2006; Morton and Wiedenbeck 2009; Nambisan et al. 2013; Tang et al. 2006a; Vishwanath and Scamurra 2007)	General system theory	3		
Communication Mechanisms	"Implementation of communication mechanisms that function at the grassroots level and target independent physicians to promote and facilitate EMR use will be positively related to the adoption and sustained use of EMR by small practice physicians." ((Nambisan et al. 2013), page 4)	(Ash and Bates 2005; Bahensky et al. 2008; Nambisan et al. 2013)	General system theory IDT	3		

Table 2.9 Organizational factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Making Computing more Natural for Users	"Another way in which management attempted to change attitudes towards the system was to help users feel more comfortable with computing in general by supporting their use of computers in other contexts. Computers were installed in reading rooms and resting rooms for the heath staff that they can use for general purposes, such as sending email and surfing the Internet..." ((Scholl et al. 2011), page 265)	(Scholl et al. 2011)	n/a	1		
Experience	This factor consists of experience by other users with EMR systems and recommendations from users' colleagues.	(Ayers et al. 2009; Albert Boonstra and Broekhuis 2010b; Castillo et al. 2010; Holden 2011; Linder et al. 2006; Ludwick and Doucette 2009; Singh et al. 2012)	Network effects theory	5		2
Interactions Between Health Practitioners and Patients	"…. Some HPs are concerned that EHRs will create a shift in the physician-patient relationship which will result in a loss of HP control and a shift in work responsibilities which will result in HPs becoming an "expensive order entry clerk"." ((Cotea 2010), page 12)	(Cotea 2010; Linder et al. 2006; Ludwick and Doucette 2009; Morton and Wiedenbeck 2009, 2010)	Resource dependence theory	5		
Management Supports	One of the main important factors that impact on EMR adoption is support from the management level (Albert Boonstra and Broekhuis 2010b). If managers in healthcare sectors support new system, other stakeholders accept the system and try to improve their skills.	(Albert Boonstra and Broekhuis 2010b; Chae et al. 2011; Gans et al. 2005; Holden 2011; Ludwick and Doucette 2009; Morton and Wiedenbeck 2009, 2010; Vishwanath and Scamurra 2007)	Nolan's Stages of Growth Model UTAUT	9		
Observability	"Observability indicates to what extent others are able to observe the innovation…., most individuals will observe others using the software. Observability should have a positive effect on an individual's attitude toward using the EHR." ((Hewitt 2009), page 2)	(Cotea 2010; Hewitt 2009)	IDT	2		

Table 2.9 Organizational factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Cultural Changes	"..... the change of culture required to accompany a switch from the use of paper to an EMR system does not occur, and that this leads to slow adoption of EMR systems." ((Tang et al. 2006a), page 12)	(Albert Boonstra and Broekhuis 2010b; Gagnon et al. 2009; Holden 2011; Nambisan et al. 2013; Tang et al. 2006a)	General system theory	5		
Incentives (Motivational Factors)	"….. and government reimbursement or incentives were the most requested facilitators of their adoption." ((Yoon et al. 2012), page 196)	(Andrew Schwarz 2011; Ash and Bates 2005; Albert Boonstra and Broekhuis 2010b; Cotea 2010; Gagnon et al. 2009; Holden 2011; A. Lee 2011; Miller and Sim 2004; Peterson et al. 2011; Simon et al. 2007; Yoon et al. 2012)	IDT	11		
Penalties	Penalties from the federal government have impact on non-adopters and these actions can motivate users to accept EMR system(Andrew Schwarz 2011).	(Andrew Schwarz 2011)	n/a	1		
Task Fit	"Since a lower task fit causes medical professionals to constantly rethink their actions, and time in this context is of utmost importance, we believe that this might be another major source for resistance; regardless of the previous matter of "cognitive switching costs", "Task-fit while using the EMR will positively influence the development of automatic behavior." ((Mettler 2012), page 5)	(Norm Archer and Cocosila 2009, 2011; Mettler 2012; Shaw and Manwani 2011)	n/a	4		

Table 2.9 Organizational factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Ownership Stake by Physicians	"The degree to which physicians have an ownership stake in his or her clinical practice varies from full ownership, to some level of part ownership, to no ownership (e.g., an employee). Physician-owned practices represent an organization where the physician has some level of financial risk in the organization's success or failure… Physicians with an ownership stake in his or her practice are less likely to adopt EHR systems than physicians who are not full- or part owners of the physician practice, controlling for physician and practice characteristics."((Bramble et al. 2010), page 57)	(Bramble et al. 2010; Holden 2011)	Resource dependence theory	2		
Workflow Issues	"clinical workflow must be taken into consideration to optimize the integration of electronic health records into the routine clinical practice… workflow electronic documents might be used to promote self-learning, and assist users to reduce uncertainty about an innovation. In addition, workflow impact can modify the perceived characteristics of an innovation, which is critical in the persuasion stage of the innovation decision process."((Castillo et al. 2010), page 10)	(Castillo et al. 2010; Cotea 2010; Ford et al. 2006; Holden 2011; Jialin Liu 2012; Noteboom et al. 2012; Pinaire 2009; Tang et al. 2006a; Vishwanath and Scamurra 2007)	n/a	8		
Social Norms	"Social norms are composed by normative and role beliefs. Normative beliefs consist of the internalisation by an individual of referent people or groups' opinion about the realisation of the behaviour, whereas role beliefs reflect the extent to which an individual thinks someone of his or her age, gender and social position should or should not behave…"((Gagnon et al. 2010), page 5)	(Gagnon et al. 2010; Nov and Schecter 2012)	TRA TPB	2		

Table 2.10 Financial factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Start-up Costs	At initial stage of any project there are various start-up costs such as making contract, install system, initial data entry and also the first phase of training of system. These factors impact directly on EMR adoption.	(Singh et al. 2012)	IDT		4	
On-going Costs	These factors are related to long-term costs after installation such as administration, control, implementing, upgrading system costs. All of these costs make EMR users unwilling to accept the system.	(Bahensky et al. 2008; Binti Ismail and Binti Abdullah 2011; Albert Boonstra and Broekhuis 2010b; Chen and Lee 2012; Cotea 2010; Davidson and Heslinga 2006; Gans et al. 2005; Holden 2011; Jha et al. 2009; Kemper et al. 2006; Ludwick and Doucette 2009; Miller and Sim 2004; Randeree 2007; Rao et al. 2011; Simon et al. 2007; Singh et al. 2012; Sittig and Singh 2011; Stream 2009; Vishwanath and Scamurra 2007; Tiankai Wang and Biedermann 2012)	IDT		19	1
Financial Resources	Sufficient financial resources are important issues to cover start-up and on-going costs. If health organizations do not have enough financial funds, they cannot adopt EMR system properly (Sittig and Singh 2011).	(Albert Boonstra and Broekhuis 2010b; Gans et al. 2005; Ginn et al. 2011; Kazley and Ozcan 2007; Sittig and Singh 2011; Tarmizi et al. 2006; Yoon et al. 2012)	TPB	7		
Uncertainty Over Return on Investment	One of the most important EMR barriers is uncertainty about return on the investment (ROI) in an EMR system (Yoon et al. 2012).	(Chen and Lee 2012; Gagnon et al. 2009; Gans et al. 2005; Holden 2011; Kemper et al. 2006; Peterson et al. 2011; Rao et al. 2011; Singh et al. 2012; Vishwanath and Scamurra 2007; Yoon et al. 2012)	n/a		10	
Type of Insurance	This factor is related to reimbursement issues. Types of insurance assesses the relationships between user adoption and three types of healthcare insurance: Medicare, Medicaid and private payer (Menachemi et al. 2007).	(Abdolrasulnia et al. 2008; Ford 2009, 2012a; Ginn et al. 2011; Kazley and Ozcan 2007; C. Li and West-Strum 2010; Menachemi et al. 2007; Vishwanath and Scamurra 2007)	n/a	6		1

2.3.2.3.7 Legal Factors

EMR stores medical information about healthcare systems and it can be vulnerable in terms of confidentiality, integrity and availability issues. This category is composed of some legal concepts such as security and privacy concerns, legal liability concerns, and policies and standards. Security issues, including confidentiality, integrity and availability, are the major concerns in EMR adoption. E-health scholars have generally stated that concerns about security and privacy issues have negative consequences on EMR adoption (see Table 2.11). Health providers should have access to patients information, which is stored in healthcare records. Some health providers are doubtful about storing patents' data in the EMR systems. They are worried that information in the EMR may be accessible to unauthorized people. Therefore, the consequences of EMR security breaches might lead to legal problems and this is very important as one of the biggest challenges in EMR adoption (Albert Boonstra and Broekhuis 2010b; Tang et al. 2006a; Yoon et al. 2012). In contrast to security, privacy and legal concerns, policies and standards positively influence a patient's adoption of EMR use. The role of standards and regulations has played a vital role in establishing and retaining users' trust in healthcare organizations (Kok et al. 2011; Miller and Sim 2004).

2.3.2.3.8 Technical Factors

EMR systems consist of complex software and hardware. Suppliers and end users should have certain skills to apply EMR in their workplaces. There are 12 technical factors: technical training, technical supports, compatibility/interoperability, technical system features, customizability, system reliability, communication tools, initial data entry, input of historic medical data into EMR, time, stepwise implementation, and system usability.

Table 2.11 Legal factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Security and Privacy Concerns	Some EMR experts have believed that using computerized EMR system can make concern about patients' privacy. Some EMR stakeholders are doubtful about security of EMR systems and they think that EMR data can be accessible to unauthorized people like hackers. Security issues related to confidentiality, integrity and availability that have major role in EMR adoption (Vishwanath and Scamurra 2007).	(Andrew Schwarz 2011; Norm Archer and Cocosila 2009; Bahensky et al. 2008; Binti Ismail and Binti Abdullah 2011; Albert Boonstra and Broekhuis 2010b; Gans et al. 2005; Hewitt 2009; Hier et al. 2005; Jha et al. 2009; Kok et al. 2011; Likourezos et al. 2004; Ludwick and Doucette 2009; Pinaire 2009; Randeree 2007; Simon et al. 2007; Sittig and Singh 2011; Stream 2009; Tang et al. 2006a; Vathanophas and Pacharapha 2010; Vishwanath and Scamurra 2007; Yoon et al. 2012)	TAM TPB UTAUT		20	
Legal Liability Concerns	This factor covers some concerns about some legal issues such as record tampering, legality of accepting of EMR from hospitals, physician's legal liability (Rao et al. 2011).	(Andrew Schwarz 2011; Binti Ismail and Binti Abdullah 2011; Rao et al. 2011; Sittig and Singh 2011; Tang et al. 2006a; Yoon et al. 2012)	n/a		6	
Policies and Standards	"Since the industry has not standardized on one format in which to record, transmit and store records, each vendor has created their own proprietary solution. These solutions do not do a good job to communicating with each other thereby minimizing the benefits and increasing the time and cost to facilitate intersystem communication"((Pinaire 2009), page 4)	(Bahensky et al. 2008; Albert Boonstra and Broekhuis 2010b; Chae et al. 2011; Cotea 2010; Ford 2009; Gagnon et al. 2009; Holden 2011; Kok et al. 2011; A. Lee 2011; Ludwick and Doucette 2009; Marques et al. 2011; Miller and Sim 2004; Pinaire 2009; Rahman and Ko 2012; Stream 2009; Tarmizi et al. 2006; Vishwanath and Scamurra 2007; Withrow 2008; Yoon et al. 2012)	n/a	18		1

Table 2.12 shows a list of technical factors derived from the literature. The results indicate that technical factors that have an impact on EMR adoption have been theorized by IDT, UTAUT, and general system theory. However, this study finds that nine of the technical factors have not been justified by any theory in the papers. For example, based on IDT and UTAUT theories, training in computer proficiency among health providers can play a key role in increasing the adoption of EMR systems. Actually, one of the most important barriers to EMR adoption is a lack of computer proficiency. Some health providers are interested in paper-based documents instead of using computers. If these providers cannot embrace computer technology in their workplaces, the adoption of EMR systems can rapidly decrease in healthcare (Pinaire 2009).

Moreover, customizability is an important factor for enhancing EMR adoption. It is defined as the ability of the system to conform to specific needs of the end user. Physicians are reluctant to adopt static EMR systems that do not support their personal styles and workflow. For example, doctors like to have their own letter format and adjust it based on their needs (Randeree 2007). Furthermore, complexity and usability difficulties are great barriers in EMR adoption (Albert Boonstra and Broekhuis 2010b). Many EMR systems have ergonomic problems. For instance, some health providers use CRT monitors that are really dark, making the interface hard to read. EMR systems should adjust in terms of brightness and contrast in order to be accessible in the different lighting conditions in healthcare. Finally, some healthcare environments need portable devices, but in some cases EMR systems cannot run properly on these devices. Therefore, some subjects such as touch screen, memory and processor issues, and navigation system impact on EMR adoption in healthcare environments that use portable devices (Rose et al. 2005).

Table 2.12 Technical factors impacting EMR adoption						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Technical Training	"training in computer proficiency among physicians may be the key to increasing the acceptance of EMR technology…"((Pinaire 2009), page 4)	(Ash and Bates 2005; Chen and Lee 2012; Cotea 2010; Ford et al. 2006; Gans et al. 2005; Granlien and Hertzum 2012; Hier et al. 2005; Holden 2011; Jha et al. 2009; A. Lee 2011; Ludwick and Doucette 2009; Morton and Wiedenbeck 2009, 2010; Pinaire 2009; Singh et al. 2012; Stream 2009; Terry et al. 2009; Vishwanath and Scamurra 2007; Withrow 2008; Yoon et al. 2012)	IDT UTAUT	20		
Technical Supports	"One such barrier includes the lack of access to internal IT support staff versus having to outsource for technical support services …. by addressing these barriers, physicians may be in a better position to adopt EHR system into his or her practice."((Bramble et al. 2010), page 56)	(Bahensky et al. 2008; Bramble et al. 2010; Castillo et al. 2010; Ford et al. 2006; Gans et al. 2005; Granlien and Hertzum 2012; Holden 2011; Jha et al. 2009; Miller and Sim 2004; Price et al. 2011; Simon et al. 2007; Stream 2009; Tarmizi et al. 2006; Tiankai Wang and Biedermann 2012; Withrow 2008; Yoon et al. 2012)	TPB	16		
Compatibility/ Interoperability	"...non-interoperable electronic health records may negatively impact workflow and productivity, which in turn contributes to clinicians' resistance to adopt these systems...."((Castillo et al. 2010), page 10)	(Andrew Schwarz 2011; Castillo et al. 2010; Cotea 2010; Gans et al. 2005; Hewitt 2009; Kemper et al. 2006; Rao et al. 2011; Tiankai Wang and Biedermann 2012; Yoon et al. 2012)	IDT	9		
Technical System Features	"A user-friendly EMR will effectively balance information needs with screen real estate, or risk adding unnecessary burdens to clinician workflows."((Rose et al. 2005), page 58). This factor focuses on software design issues, information retrieval and navigation and system context.	(Binti Ismail and Binti Abdullah 2011; Cotea 2010; Haughom et al. 2011; Hier et al. 2005; Holden 2011; Jensen and Aanestad 2006; Jialin Liu 2012; Kemper et al. 2006; Kok et al. 2011; A. Lee 2011; Linder et al. 2006; Ochieng and Hosoi 2006; Price et al. 2011; Rose et al. 2005; Scholl et al. 2011; Sibona et al. 2010; Sittig and Singh 2011; Terry et al. 2009; Vathanophas and Pacharapha 2010; Walji et al. 2012; Tiankai Wang and Biedermann 2012)	n/a	21		

Table 2.12 Technical factors impacting EMR adoption (Continued)

Factor	Sample Conclusion	References	Theories	Positive	Negative	Non-significant
Customizability	"Customizability refers to the ability of the technology systems to conform to specific needs of the user applications…Physician's reluctance to adopt may stem from the view that EMRs will negatively affect workflow, are more costly, consume more time, and do not meet their personal styles."((Randeree 2007), page 494)	(Albert Boonstra and Broekhuis 2010b; Jialin Liu 2012; A. Lee 2011; Randeree 2007; Vishwanath and Scamurra 2007)	n/a	5		
System Reliability	"Reliability is the dependability of the technology systems that comprise the EMRs. High reliability is very important for a system dealing with patient information, and many physicians are concerned about the temporary loss of access to patient records if computers crash, viruses attack or the power fails…((Albert Boonstra and Broekhuis 2010b), page 9)	(Andrew Schwarz 2011; Albert Boonstra and Broekhuis 2010b; Marques et al. 2011)	n/a	3		
Communication Tools	"Communication tools such as social media (which is the fastest tool for the social contagion and social cohesion methods) will be positively related to the adoption and diffusion of EMRs among independent physicians in small practice settings."((Nambisan et al. 2013), page 4)	(Nambisan et al. 2013)	General system theory	1		
System Usability	"EMR usability positively affects healthcare professions' perceived ease of use."((Vathanophas and Pacharapha 2010), page 4)	(Carayon et al. 2011; Cotea 2010; Granlien and Hertzum 2012; Holden 2011; Jensen and Aanestad 2006; Rose et al. 2005; Scholl et al. 2011; Sittig and Singh 2011; Vathanophas and Pacharapha 2010)	n/a	9		
Initial Data Entry	Initial data entry is of the important elements of start-up cost. It is too labour intensive and takes time(Singh et al. 2012).	(Gans et al. 2005; Haughom et al. 2011; Jha et al. 2009; Rao et al. 2011; Simon et al. 2007; Singh et al. 2012)	n/a	6		

Table 2.12 Technical factors impacting EMR adoption (Continued)						
Factor	**Sample Conclusion**	**References**	**Theories**	**Positive**	**Negative**	**Non-significant**
Input of Historic Medical Data into EMR	"Although EHR systems have been in existence for decades, the inability to input historical data is still a big barrier to EHR adoption and utilization..."((Tiankai Wang and Biedermann 2012), page 4)	(Gans et al. 2005; Tiankai Wang and Biedermann 2012)	n/a	2		
Time	"Time refers mainly to technical issues such as slow response times and inferior system design making it time consuming to use the EMR." ((Granlien and Hertzum 2012), page 218). However, in some cases time refers different issues such as time for training and organizing workshops.	(Angst and Agarwal 2009; Albert Boonstra and Broekhuis 2010b; Cotea 2010; Granlien and Hertzum 2012; Holden 2011; Jialin Liu 2012; Likourezos et al. 2004; Ludwick and Doucette 2009; Miller and Sim 2004; Sibona et al. 2010; Simon et al. 2007; Stream 2009; Terry et al. 2009; Vishwanath and Scamurra 2007; Tiankai Wang and Biedermann 2012)	n/a		14	
Stepwise Implementation	"The stepwise implementation process involved the system first being used at the evening outpatient clinic, and only for patients visiting the hospital for the first time. …((Scholl et al. 2011), page 964)	(Scholl et al. 2011)	n/a	1		

2.4 Personal Health Record (PHR)

In this section, the researcher gives a brief overview of PHR and then provide a systematic review on PHR adoption. After the the personally controlled electronic health record (PCEHR) system will be explained.

The relationships between healthcare providers and patients have changed from paternalistic activity-passivity to being more patient-centered (Szasz and Hollender 1956). In the past, patients passively agreed with what their physicians told them, but in the patient-centered relationship both the patients and the healthcare providers cooperate together to make healthcare decisions (Laine and Davidoff 1996). These relationships are significant in chronic disease treatment and the patients have to partner their healthcare providers, such as physicians and nurses, in making better treatment decisions (Kuhn et al. 2006). In this way, the Internet plays an active role in increasing the health literacy of patients to enable them to participate in their healthcare (Pratt et al. 2006).

Research has identified that if patients have a better understanding of their care, they can receive more optimal treatment in partnership with their healthcare providers. Therefore, patients' empowerment and activation are two important concepts that can be used to improve quality of care (Butow et al. 2004; Halamka et al. 2008; Samoocha et al. 2011).

Nowadays, patients would like to be more active in their healthcare process and need to have health information regarding better treatments available. As a matter of fact, PHR is one of the best solutions to enhancing patients' gathering, understanding and controlling health information (Civan et al. 2006; Tang et al. 2006a). The PHR is a system that gathers consumers' health information from different health sources and assists individuals in understanding and improving the quality of their care (Grant et al. 2008). This definition shows that individuals can use a PHR

system to collect their own personal health information and medical history in one integrated system, which is accessible from anywhere by authorized persons. The PHR system empowers individuals with functionality to access and track their own health record and use that health data to play an active role in their wellness and self-care (Civan et al. 2006). The PHR contains health information that is managed by individuals. It is a useful tool that maintains individuals' wellness and also helps patients to treat their illnesses. The PHR system contrasts with that of the EMR system, which involves the health records of patients and is managed by health providers such as physicians and healthcare institutions.

Different types of systems are the issue of debate in the current PHR marketplace, but they can be categorized into three classes (D. Detmer et al. 2008). The first category is a stand-alone PHR, which is completely created and managed by individuals. It allows the patients to enter health data, which is gathered from different disparate sources, into a single digital health record. Examples of this web-based PHR model are https://www.healthvault.com, www.revolutionhealth.org, and www.webmd.com/phr/. Unfortunately, this model has some barriers preventing individuals from adopting it. Most importantly is that there are no uniform standards to integrate health information that is obtained from different patient sources of healthcare. Therefore, in this case individuals need to manually enter their own health data, and this entails a significant health record-keeping workload. This PHR system depends on individuals' input and it is unlikely to provide trusted data for transmission among different healthcare institutions (D. Detmer et al. 2008; Hobson 2009; Tang et al. 2006a).

The second class is a payer- or employer-based PHR, which is offered by the large employers – such as General Motors, Dell, IBM and Walmart, which is an American multinational retail corporation, Centers for Medicare and Medicaid Services (CMS) – who provide PHR systems for

their employees to increase individuals' responsibilities in their healthcare. This model is also faced by integration standard problems (D. Detmer et al. 2008).

The third class of PHR is an integrated model, which is integrated with at least one of the individual EMR systems. This integrated PHR model allows individuals to be more interactive with their health providers and permits individuals to access health data that is stored in their EMR systems(D. Detmer et al. 2008).

Recent research has shown that PHR systems have various benefits. Individuals can access a wide range of valuable health-related information and knowledge from PHR systems. Furthermore, patients can play an active role in decisions about their treatment and are able to manage their diseases. They can discuss their health conditions with their healthcare professionals based on recorded information in PHR systems. For instance, patients with chronic disease can track their health problems in conjunction with their physicians and other healthcare providers. Moreover, PHR systems can improve patients' communication with caregivers by providing a collaborative disease disease-tracing process, the facility to set up appointment systems, report problems, and a searchable "frequently asked questions" portal. For healthcare providers, the PHR systems have brought a wide range of benefits, such as reducing medication errors (due to poor handwriting, for example), increasing identification of drug-to-drug contradictions that lead to allergies, and reducing unnecessary tests and procedures (Henriksen 2008; Murray 2000).

Although some research studies have shown the benefits of PHR systems in healthcare, other research suggests that PHRs have not been adopted as originally expected. For example, Kim and colleagues (E. H. Kim, Stolyar, A., Lober, W.B., Herbaugh, A.L., Shinstrom, S.E. Zierler, B.K. Soh, C.B. Kim, Y. 2009) conducted a study over a 33-month period in the United States. They

deployed a web-based, institution-neutral PHR, the Personal Health Information Management System (PHIMS), in a federally funded housing facility for low-income and elderly residents. They evaluated use and user adoption through system logs, questionnaire surveys, and user group meetings. Despite the PHIMS being available for free and personal assistance and computers with Internet connections being provided without any cost to individuals, only 13% of the residents applied the system in their healthcare. Almost one half of the users only applied the PHIMS on one single day. This low adoption rate may be due to poor computer and Internet skills, low health literacy, and poor health status (physical and cognitive impairments).

In addition, according to a national survey in the US, 62% of American physicians have not had previous experience with using a PHR system, although 42% of them claimed that they were willing to try applying one with their patients. Similarly, consumers' knowledge was found to be limited, with more than half of individuals reporting that they were not familiar with the value and use of PHR systems (Nazi 2013).

If individuals are to benefit from the application of PHRs, it is crucial to understand the facilitators and barriers impacting on PHR adoption. While there are various studies on PHR adoption that describe some of the PHR adoption factors, none of them provide a comprehensive review of facilitators of and barriers to PHR adoption. In response to this, the purpose of this research is to provide a comprehensive taxonomy of the factors affecting PHR adoption and to categorize these factors into meaningful clusters.

2.4.1 A Systematic Review on PHR Adoption

Many studies have conducted research on the use of technology and its impacts (A. H. Ghapanchi, Aurum, A. 2011, 2012b; A. H. Ghapanchi, Aurum, A., Daneshgar, F. 2012c; A. H. Ghapanchi, Aurum, A. 2012a; A. H. Ghapanchi, Aurum, A., Wohlin, C. 2014; Zarei 2010). There are various research studies that focused on HIS. For instance, a taxonomy of different EMR research areas identified eight main categories of research including design and development, EMR impact , EMR adoption, integration, evaluation, medical research, EMR data design and management, and policies and standards (M. Najaftorkaman, Ghapanchi, A.H., Talaei-Khoei, A. and Ray, P. 2013). After that, Najaftorkaman and colleagues (M. Najaftorkaman, Ghapanchi, A.H., Talaei-Khoei, A. and Ray, P. 2014) proposed a comprehensive taxonomy of factors impacting on EMR adoption. They searched almost 10,000 articles and found 89 relevant papers covering EMR adoption. From these papers, they identified a list of 78 factors impacting on EMR adoption. These factors were classified into the following eight categories: individual, psychological, behavioural, environmental, organizational, financial, legal, and technical factors.

In the case of PHR systems, Kaelber and colleagues (Kaelber 2008) reviewed PHR studies and found 100 related research studies. They divided the PHR research areas into seven categories, of which four in particular presented important research opportunities. The main category was PHR function evaluation which focused on information collection, information sharing, information exchange, and information self-management functions. The second category was PHR adoption and attitudes that described attitudinal and physical PHR adoption barriers among individuals and healthcare providers. The next category, PHR privacy and security, described individuals' concerns around the privacy and security of their health-related information. It covered security concepts such as confidentiality, integrity, and availability of PHR systems. The final PHR

research area was architecture, which focused on three main PHR components: data, infrastructure, and applications. PHR data are the types of health-related information that are analysed, exchanged, and stored in the PHR system. PHR infrastructure encompasses computing platforms, software packages, functions, or websites that exchange and process health-related information. PHR applications are the capabilities and outcomes of PHR systems themselves, and are enabled through PHR data and infrastructure.

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Among current PHR adoption research articles, there is just one systematic review which does not have a comprehensive model of factors impacting on PHR adoption (Jabour 2013). It used

three databases as a resource, searching: PubMed, IEEE, and Google Scholar including papers published between January, 2001 and September, 2012. The main PHR adoption barriers were identified as physical limitation, health condition, not knowing about the system and its functions, access issues, computer literacy, social divide, digital divide, computer anxiety, cognitive barriers, and health literacy. PHR adoption facilitators included promotional advertisements, system modification to user preferences, training and education, staff assistance, communication features, and provision of free devices. This study had some weaknesses: (1) it excluded qualitative research in its review process (qualitative study can provide valuable research data); (2) it only focused on patients using the PHR system and excluded healthcare providers from their primary data sources; and (3) although there were useful PHR adoption research papers in 2013 and 2014, this study included papers published before September 2012.

2.4.2.1 Research Methodology to Conduct Systematic Review on PHR Adoption

The researcher carried out a systematic literature review to identify factors influencing the adoption of EMR systems, using the following approach (M. Najaftorkaman et al. 2013a). Science Direct, Scopus, ProQuest, PubMed, IEEE Xplore, ACM Digital Library, Association for Information Systems electronic library, SpringerLink, and Thomson Reuters' Web of Science became nine databases of choice in this systematic review. They provided access to studies from various fields, including engineering, healthcare, health informatics, human-computer interaction, computer science, psychology, and other areas.

The researcher applied three major categories of search terms. The first category emphasizes different PHR terms and definitions, the second category focuses on adoption terms and concepts, and the last category is based on impact terminologies. Figure 2.11 displays the three categories

of search terms that were applied in this research. In fact, the researcher was looking for relevant studies that assessed different factors affecting PHR adoption.

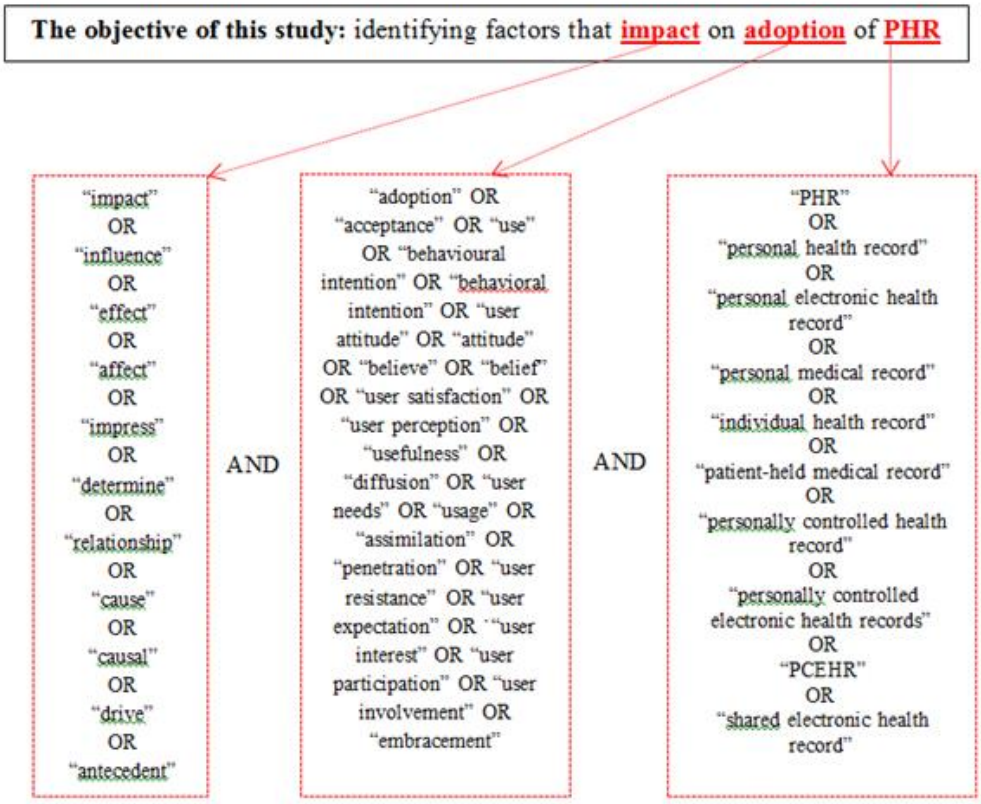


Figure 2.11 The categories of search terms

Figure 2.12 shows the phases of the study selection process applied in this systematic review. The first phase included searching for keyword terms (Figure 2.11) on nine databases (see Resources Searched section). Consequently, 7,653 primary papers were recognized for initial screening. Following this, the researcher excluded papers on the basis of their titles (6,368 papers excluded; n=1,285). For instance, in the PubMed database, the researcher applied the Advanced Search Section of the online database and inserted the three groups of keyword terms and hit the

search button. The researcher read the titles of all the articles and excluded them on that basis. Phase 3 involved excluding papers on the basis of their abstracts (686 papers excluded; n=599). In this phase, the researcher read all the abstracts of the downloaded studies and retained all relevant papers. In the final phase, duplicated papers were omitted and the researcher read the full texts of the remaining papers (477 articles excluded; N=122). As a result of these phases, he had 122 relevant articles based on factors affecting PHR adoption.

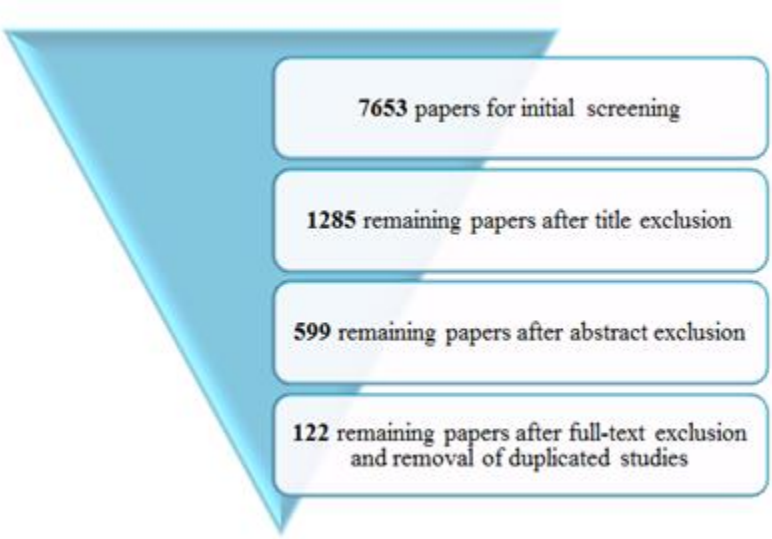


Figure 2.12 Phases of the study selection process

Furthermore, Table 2.13 illustrates the number of articles at each phase of the selection process. There were 7,653 articles initially, and after title, abstract, duplication, and full paper exclusion, 91 research studies remained. Based on definitions and terminologies of adoption factors in the 122 selected studies, a list of 53 factors impacting on PHR adoption was identified. At this stage, some of the factors were merged according to their meaning and explanation of adoption.

Table 2.13 Number of papers in different stages of study selection process

Database	Initial number of papers	Remaining papers (title exclusion)	Remaining papers (abstract exclusion)	Remaining papers (full-paper exclusion and removing duplicated papers)
Science Direct	1503	248	185	15
Scopus	2891	352	131	34
ProQuest	874	141	51	9
PubMed	1277	205	83	15
IEEE Xplore	226	35	24	12
ACM Digital Library	107	36	23	9
Association for Information Systems electronic library	67	21	12	8
SpringerLink	337	112	33	7
Thomson Reuters' Web of Science	372	135	57	13
Total	**7653**	**1285**	**599**	**122**

Following this, the researcher attempted to categorize the 53 adoption factors, extracted from the literature, into meaningful clusters in order to produce a comprehensive taxonomy. To complete this stage, the authors went through the review sources in various research areas such as PHR development, policy and standard, PHR usage in healthcare, and medical research. The

authors assigned a suitable label to each identified factor according to its terms and terminologies in the previous research studies (M. Najaftorkaman, Ghapanchi, A.H., Talaei-Khoei, A. and Ray, P. 2014). Table 2.14 shows how the academics assigned the factors to the main categories and how the proportion of inter-judge agreement was clarified for each category.

Table 2.14 Inter-judge agreement for the main categories

Factors	**Judges**			**Consensus**	**1&2 agree?**	**1&3 agree?**	**2&3 agree?**	**Agreements**
	1	**2**						
Age	I [a]	I		I	Yes	Yes	Yes	3
Race/ethnicity	I	I		I	Yes	Yes	Yes	3
Technology anxiety	P	I		P	No	Yes	No	1
Autonomy	P	P		P	Yes	No	No	1
Higher skill	I	I		I	Yes	Yes	Yes	3
Incentive motivation	P	P		P	Yes	No	No	1
Health consciousness	H	H		H	Yes	Yes	Yes	3
…								

I [a]: "Individual"; P: "Psychological"; H:"Health-related"; L:"Legal"; E: "Environmental"; T: "Technological"

After finishing the labelling process, the researcher had three iterative rounds to achieve a better classification of adoption factors impacting on PHR adoption. Some labels were renamed or merged in the second and third rounds to arrive at the final taxonomy. Finally, the researcher identified six labels: individual, psychological, health-related, legal, environmental, and technological factors. Subsequently, as a validation process, the researcher presented the rationale behind the 53 adoption factors and the six categories to three academics in health informatics. The researcher asked them to map the 53 factors against the six labels. The researcher achieved 159 (53×3) possibilities from the three academics. To conclude the process, the authors finalized all possibilities and produced the final taxonomy of adoption factors impacting on PHR systems. Figure 2.13 demonstrates the data analysis process undertaken to carry out this systematic literature review.

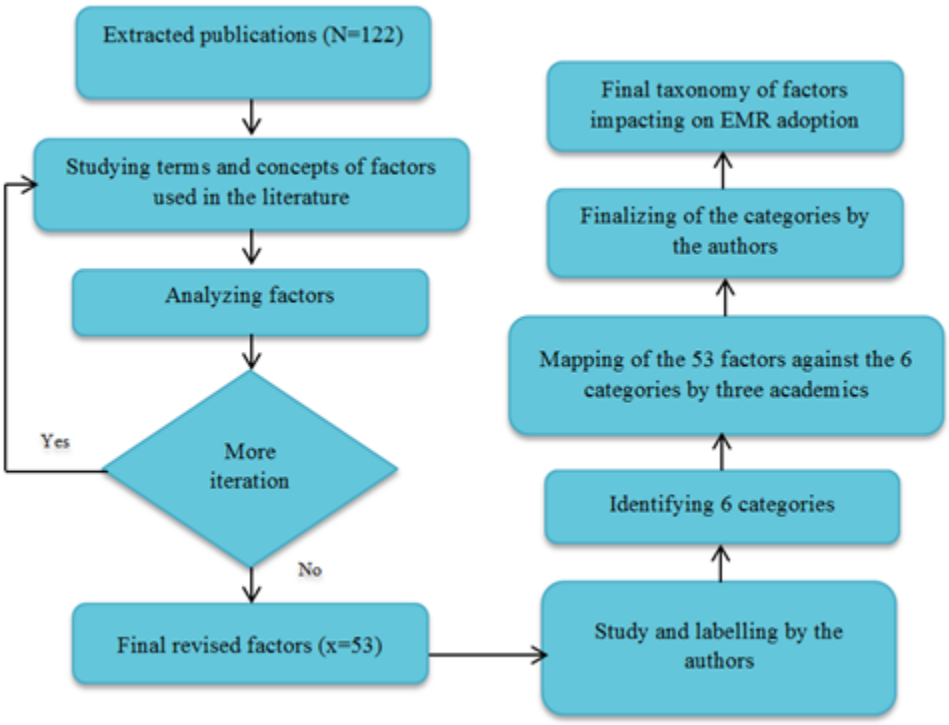


Figure 2.13 Data analysis process

2.4.2.2 Theoretical Perspectives in PHR Adoption Literature

As a part of this systematic review, 18 distinct theories and model identified as theoretical foundation on the PHR adoption research studies. In fact, many studies on PHR adoption have not applied any theories to frame the research and evaluate their results. The list of the theories is actual data extracted from the source of systematic review. The researcher collected the theories that were used in the PHR literature and summarized them into Figure 4 in order to show the theories that have been used most often in previous research.

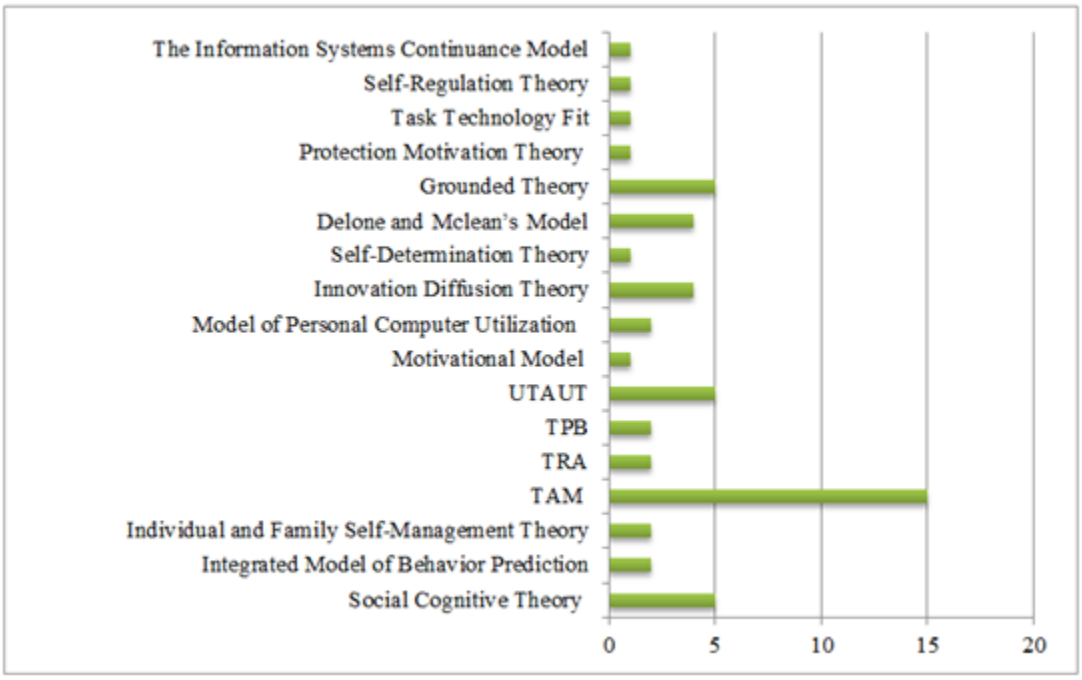


Figure 2.14 Distribution of the papers over different theories

The theories that have been used in PHR adoption studies are: social cognitive theory, integrated model of behavior prediction, individual and family self-management theory, technology acceptance model (TAM), theory of reasoned action (TRA), theory of planed

behavior (TPB), theory of acceptance and use of technology (UTAUT), motivational model, model of personal computer utilization, innovation diffusion theory, self-determination theory, Delone and Mclean's model, grounded theory, protection motivation theory, task technology fit, self-regulation theory, and the information systems continuance model.

2.4.2.3 Taxonomy of Antecedents to PHR Adoption in the Literature

As a result of the study selection phases, there were 122 relevant articles that focused on factors affecting PHR adoption. The researcher read the full text of all 122 articles and extracted the factors that impacted PHR adoption. Some factors were merged according to their meaning and explanation of adoption. Finally, he created a list of 51 factors that impacted individuals' behaviour to adopt the PHR system. In this stage, the researcher attempted to categorize these factors that had been extracted from the literature (actual data) in order to present a clear taxonomy of factors that impact PHR adoption. Figure 2.15 presents the taxonomy of the 51 factors, categorized into six groups: individual, psychological, health-related factors, legal, environmental, and technological factors. The researcher created a table for each category that contains the name of the factors, sample conclusions extracted from the literature, and related reference.

2.4.2.3.1 Individual factors

The individual factors category describes 10 individual characteristics that consist of: age, gender, marital status, race/ethnicity, higher education level, employment status, higher income, higher e-health literacy, higher health numeracy, and higher verbal ability. Table 3 lists sample conclusions for each of the 10 individual characteristics from the extracted research articles to provide key insights into PHR consumers.

Figure 2.15 Our taxonomy for factors impacting PHR adoption

For example, there are various studies that evaluate age-related factors on PHR adoption (Lober 2006; Roblin 2009). Tulu and colleagues (Tulu 2012) applied a mixed-method research methodology and identified that, overall, PHR systems are used more frequently by older patients than younger ones. On the other hand, Wen and colleagues (Wen 2010) concluded that patients aged 65 and over perceived less value in PHR usage and were therefore less likely to apply a PHR system in their healthcare than younger patients.

In addition, the literature showed that patients on unemployment benefits would like to have a full copy of their health-related information, while those employed preferred a summary of their medical records in their PHR. The main reason for unemployed patients being more likely to use the PHR system was thought to be that they have more time available to monitor, manage and track their health-related information (S. T. Liaw 1993).

Furthermore according to the literature, e-health literacy plays important role in PHR adoption (Chan et al. 2009; Noblin 2012). E-health literacy includes traditional literacy, health literacy, information literacy, scientific literacy, media literacy, computer literacy, and Internet literacy (M. D. Logue, Effken, J.A. 2012). Health literacy completely depends on a user's ability to understand and act on health-related information. PHR users should be able to obtain process and understand at least an elementary level of health education. Computer and Internet literacy is another important knowledge for users to be able to update PHRs and interact with the PHR system (Wen 2010). Therefore, users with a greater computer literacy are more likely to adopt PHR systems (J. S. Kahn, Aulakh, V., Bosworth, A. 2009; Noblin 2012; Wen 2010).

Moreover, health numeracy is another important factor that impacts on PHR adoption, can be divided into four categories based on the literature (Mayberry et al. 2011; Taha 2013): (1) basic

health numeracy, which focuses on identifying numbers and understanding of qualitative data, requiring no manipulation of numbers; (2) computational health literacy, which involves simple counting, quantifying, and computing of qualitative data; (3) analytical health numeracy, which involves higher-level computation skills such as inference, estimation, percentages, and frequencies; and (4) statistical health numeracy, which involves the ability to compare information shown in different scales such as probability, proportion, and percentage to analyze health-related information involving life expectancy and risk. According to the literature (Taha 2013), PHR users with a higher level of health numeracy are more likely to adopt PHRs because this is a critical skill for users to be able to complete the more complex tasks such as interpreting test results, managing a missed medication dose, and understanding graphical health-related information.

2.4.2.3.2 Psychological factors

Psychological factors are composed of 18 antecedents: self-efficacy, communication preferences, attitudes, outcome expectations, self-management perceptions, effort expectancy, technology anxiety, autonomy, lack of trust, personal innovativeness, information-seeking preferences, health providers' perceptions, concerns about sharing information, opt in or opt out, perceived complexity of treatment, incentive motivation, perceived usefulness, and perceived ease of use.

For example, self-efficacy is one of the most important psychological factors impacting on PHR adoption based on the literature (Chrischilles et al. 2014). Studies have shown that PHR users who demonstrated a higher level of confidence in managing their health (activated users) were more likely to adopt the system (Agarwal 2013). Self-efficacy is a key factor for behavioral change. Behavioral change in social science is not an easy task. In PHR adoption, change

management concepts involve providers and consumers (individuals). There must be an enthusiasm to change. Individuals need to understand how PHR systems can improve their quality of healthcare by offering various functions to facilitate information management (J. S. Kahn, Aulakh, V., Bosworth, A. 2009).

Additionally, the literature showed that positive perception of healthcare provides toward using PHR can have positive impact on the individual's adoption of PHR (Czaja et al. 2014; Wells et al. 2014). Much of the medical information in PHR systems such as test results, treatment plans, and information of about medication can be obtained from a specific health provider. When an individual brings medical records from one provider or another, health-related information from one health provider is being shared with the other through a PHR system. A greater contribution from healthcare providers in the data input process could enhance the quality of PHR data, and so increases the utility of PHR systems. According to the literature (Dawson 2009), it is essential that medical records are shared with caution and comprehensive instructions should be included to mitigate any possible misinterpretation of health-related information. Sharing medical information is useful because of its potential to reduce medical conflicts, avoid drug side effects, and decrease an individual's exposure to allergens.

In addition to psychological factors, the literature showed that many providers had concerns about sharing too much health-related information with patients in case this caused unnecessary anxiety for them (Huba 2012). It was generally believed that, because of the complex and technical nature of health data, it was easy for an individual unfamiliar with this language (medical jargon) to misinterpret the meanings of medical results and come to the wrong conclusions about the severity of their health condition. Furthermore, healthcare providers worried about the possibility of backfire and arguments between patients and practitioners resulting from sharing medical

records. These kind of arguments could result is in a lack of trust which could be dangerous in a healthcare environment. In addition, individuals might not completely understand the need to protect health-related information stored in PHRs. This kind of data could be used to vulnerable individuals in different legal ways: pressure to control them by an abusive spouse or parent; or as a way for an abusive person to scam them with fake drugs or treatments (Dawson 2009; Haggstrom 2011; Huba 2012).

Morovere according to the literature, some individuals will never be happy with the idea of digital records (Colorafi 2014; Macpherson et al. 2014). Many PHR expositors believe that individuals should have a yes or no decision about participating. If individuals object to the idea of digital PHRs, for these individuals, health practitioners should simply refrain from keeping a notebook or opening a computer file for them. The opt in approach is more readily adapted to allowing individuals some kind of response between yes or no; that is, an individual may be given the chance to block access to specific categories of information. On the other hand, opt-out power can be illusory, if healthcare providers say beneficially must authorize creation of PHR in order to be eligible for PHR advantages (Sprague 2006).

Finally, the literature showed that perceived usefulness and ease of use of PHR systems are important factors that can have a positive impact on PHR adoption (H. Li, Gupta, A., Zhang, J. 2010; Stolyar 2006). If consumers believe that applying PHRs in their healthcare can help them to improve their quality of care, they are more likely to adopt the system (M. D. Logue, Effken, J.A. 2013). PHR systems should bring various benefits for individuals such as reducing the amount of time spent completing documentation, facilitating communication between individuals and doctors, improving the accuracy and integrity of health-related information, increasing the overall safety of individual care, reducing the complexity of individual treatment, and reducing the number

of times that an individual asks the same question (Witry 2010). Moreover, ease of use or the level of complexity of a PHR system has a significant impact on system adoption. For example, medical jargon and advanced language used in some PHR systems can be so complex that patients are unable to interpret the medical information (L. S. Liu, Shih, P.C., Hayes, G.R. 2011).

2.4.2.3.3 Health-related factors

The third category, health-related factors, is composed of three factors: health consciousness, health status (limited physical and cognitive abilities), and health management training. It focuses on factors impacting on the health status and health behavior of individuals.

For example according to the literature (Assadi 2014; M. D. Logue, Effken, J.A. 2013), health consciousness is one of the important factors that impact on PHR adoption. Users who have a "wellness-oriented" lifestyle worry about nutrition, fitness, stress, environment, medical history, and their treatment processes (Assadi 2009). These kinds of consumers take responsibility for their health and are excellent users for PHR systems. They believe that a specific health problem can be potentially life-threatening (perceived severity). In general, if individuals are susceptible to a specific health problem, they try to behave healthily to decrease the risk of the health problems. Individuals are more likely to have healthy behaviors if they perceive a particular health problem as serious. Therefore, it is claimed that PHR users who believe that the severity of the health threat is high are more likely to adopt the system (Assadi 2009; Laugesen 2013).

In addition, the majority of studies claimed that individuals' health status has a direct impact on PHR adoption (Kannry 2012; P. C. Tang, Ash, J.S. Bates, D.W., Overhage, J.M., Sands, D.Z. 2006; Tsai 2012). For example, individuals with physical impairment may recognize the value from gathering, organizing, monitoring, and managing of health-related information, but may be

unable to complete a particular task without assistance (Macpherson et al. 2014). Furthermore, the literature showed that (Wibe et al. 2014), individuals with cognitive disabilities might have greater difficulty with one or more types of mental tasks compared with the average person. Cognitive disabilities as a result of age, Alzheimer's, dementia, developmental delays, seizures and head injury impact on the ability of users to manage and monitor their health-related information in PHRs (Makai et al. 2014).

In addition, Lober and colleagues (Lober 2006) claimed that cognitive function is a major problem for many users over the age of 65 which impacted on their PHR usage. Memory problems impacted on 11% of women over the age 65; 15% of male users in that age group had a moderate to severe disability. Interestingly, 60% of patients aged 18 and older who visited a health provider failed to remember to ask the health provider all their questions. Individuals living with human immunodeficiency virus (HIV) faced major challenges to PHR adoption because the system contains sensitive data such as laboratory tests, medications, sensitive diagnoses and treatment procedures. HIV users may therefore be reluctant to apply PHRs in their treatment process.

Finally, the literature showed that individuals' training about health management techniques is an important issue for PHR adoption (Butler 2013; Mooranian 2013). From elementary school onwards, the significance of managing an individuals' health by applying simple tools and systems need to be taught in the educational system. supporting the need to manage the quality and accuracy of health-related information in PHRs can occur as educational experiences clarify during the primary and secondary school years. These days, this type of training is available online or individuals can attend courses in medical schools, nursing schools, or university hospitals (P. C. Tang, Ash, J.S. Bates, D.W., Overhage, J.M., Sands, D.Z. 2006).

2.4.2.3.4 Legal factors

Health-related information is managed by individuals in the PHR system, and this information could therefore be vulnerable in terms of confidentiality, integrity and availability concepts. This category is composed of legal issues such as security/privacy concerns and policies and standards.

According to the literature, security and privacy concerns is one the main barriers to PHR adoption (Jian 2012; J. S. Kahn, Aulakh, V., Bosworth, A. 2009; Panchal 2013). Privacy threats are about the disclosure and subsequent use of an individual's information (Qian et al. 2014). Individuals rely on the perceived control over their health-related data disclosure as a signal to evaluate the benefits and potential privacy threats they may achieve from using the PHR system. The privacy invasion experience from using PHR reflects a user's direct experience of being a victim of privacy attack. These kinds of privacy invasions impact on PHR users' context-specific privacy beliefs and PHR adoption (Dawson 2009). PHR users who regularly experience threats to their privacy may apply trust as the major basis to evaluate privacy risks, and give less consideration to perceived privacy control. A high level of privacy control over information in the PHR system could assure individuals that healthcare providers are less likely to behave opportunistically, causing them to make more satisfactory judgments about the advantages of PHRs. For instance, individuals perceived PHRs as a useful system if they had control over sharing health-related information with their physicians and family members. Conversely, they perceived high privacy risks if they felt that they had little control over health-related information collated in the PHR system (H. Li, Gupta, A., Zhang, J., Sarathy, R. 2014).

In addition to legal factors, the literature showed that it is critical to make sure that an individual's data are kept secure and only available to users that are authorized to access it (Hilton

2012). Obviously, this is not simple to achieve since the majority of PHR data is delivered or processed through the Internet. There are some security threats that impact on data in the system such as confidentiality threats, integrity threats, and data authenticity (accuracy) threats. For instance, unauthorized modifying of information is related to data integrity (Aboelfotoh et al. 2014). Malicious users could make unauthorized alterations to an individual's data transmitted by, or stored in the PHR system. In such a case, the genuine user would receive different data from that sent by the healthcare provider. The next important security threat focuses on data confidentiality. Hackers could potentially gain unauthorized access to PHR data stored in the servers or transmitted over the Internet. Threat to data authenticity (data accuracy) is another major concern associated with PHR systems. A malicious user could create spurious data and deceive PHR users into believing that the data had been transmitted from a genuine healthcare provider. These kinds of threats could potentially cause a life threatening situation which could lead to death. Therefore, privacy disclosures and security threats are serious issues, central to the diffusion of user adoption (J. S. Kahn, Aulakh, V., Bosworth, A. 2009; Panchal 2013; Señor 2012).

Finally according to the literature (J. Xu, Gao, X., Sorwar, G., Croll, P. 2014; Yee 2006), policies and standards impact on PHR system development. To achieve an individual's safety, better quality and efficacy of care, and individual empowerment, the PHR system should able to take information from various sources and to be read by healthcare providers and others to whom the individual gives access. To achieve this goal, policies and standards for data field definitions, shared core data sets, and electronic transmission should be agreed on (Sprague 2006). Various policies and standards necessary for PHR systems are described such as: data interchange standards (to determine the structure of data and messages), minimum data set (to specify a minimum amount of data accessible to authorized individuals and healthcare providers for self-

care and clinical encounters), authentication standards (to protect against unauthorized disclosure of an individual's information), identification standards (to avoid breaches of confidentiality and preventable medical errors), security standards (to cover data security, service security, system security, and physical safeguards), data integrity standards (to ensure data has not been modified or

corrupted by unauthorized users), and privacy standards (to provide specific rights for PHR users and obligations for healthcare providers holding PHR data in order to protect health-related information) [68]. For example, there is a significant gap between the medical terminology used by healthcare practitioners and the lay language understood by the majority of patients. Studies note that increasing interest in the world around PHR systems and their potential standardization is driven by the convergent benefits available to healthcare providers, individuals, and the established medical devices industry (D. Detmer, Bloomrosen, M., Raymond, B., Tang, P. 2008; Señor 2012; Sprague 2006).

2.4.2.3.5 Environmental factors

The environmental category is composed of seven factors: social influence, physician–patient relationship, market forces, workflow models, insurer issues (private insurers), geographic location, and vendor stability.

For instance, the literature showed that social influence is an important factor that identifies social power to change the attitudes or behavior of an individual in a particular direction (Wolter and Friedman 2005). In fact, an individual's actions, reactions and thoughts can be impacted by other individuals. In this case, communication tactics can play important role to motivate people to adopt PHR. Communication tactics are the ways in which a person hears about the PHR system

through various channels such as the Internet web-pages, email messages, posters, and advertisements on television (Agarwal 2013). According to the literature (Agarwal 2013; Wolter and Friedman 2005), healthcare providers and policymakers often provide marketing messages to raise awareness of the values of PHRs to increase adoption rates of the systems. Individuals who claim to have been more exposed to communication tactics should be more aware of the advantages of PHR systems. If individuals perceive that PHR systems' functionality have value and they aware of PHR benefits to their healthcare, higher intention to use the system should result.

In addition, the literature showed that the physician–patient relationship plays important role in PHR adoption based on the literature (S. T. Liaw 1993; Stolyar 2006). It is vital to have high-quality care in the diagnosis and treatment process. Patients must have confidence in the competence of their doctor and must feel able to confide in them (Or 2011). For the majority of doctors, the establishment of a good relationship with a patient is essential (Zulman et al. 2011). If doctors and patients maintain a good relationship, patients' motivation to consult with, and provide complete and accurate information to doctors to assist further positive interaction and to achieve high-quality diagnosis and treatment, will be robust (Agarwal 2013). If an individual applies the PHR system as part of an integrated healthcare plan devised by doctors with their patients with a view to achieving a good relationship, then patients will be more likely to adopt the system. The literature showed that (Macpherson et al. 2014), the better the relationship, based on mutual respect, trust and shared values about the patient's diseases and life, the better the amount, accuracy, and integrity of information about the related diseases through the PHR system will be. The physician–patient relationship could be improved by supporting principles such as enhancing the knowledge, skills and behaviors of doctors and patients, avoiding decisions that lead to an interruption of continuity, developing standardization efforts (divided administrative rule

communications from patient care); and minimizing conflicts of interest (C. Liu, Tsai, Y., Jang, F. 2013).

Furthermore according to the literature (Grossman 2009), an individual's insurance status at the time of using a PHR is important. Insurance status can be grouped into Medicare, Medicaid, private, and self-pay (Sloan et al. 1988). Individuals with Medicare and Medicaid insurers were less likely to adopt PHR systems (Yamin 2011). They had concerns about privacy because of unclear privacy policies, the fact that insurer's employees could access an individual's self-reported data, and concerns about how insurers might use that information to restrict coverage, raise premiums, or limit benefits. Patients also had concerns about insurers' sponsorship of PHR systems. In general, the literature showed that patients do not trust sharing personal health-related information with insurers, especially Medicare and Medicaid (Grossman 2009). On the other hand, patients that use private insurers are more likely to adopt a PHR and share their health-related information because of greater feelings of trust compared with Medicare and Medicaid, more security and privacy principles applying in private insurance systems, and comprehensive policies and standards (Yamin 2011).

Additionally, as with other forms of health information systems, PHRs provide both important potential benefits for patients and a high degree of risk for investors in the healthcare industry (D. Detmer, Bloomrosen, M., Raymond, B., Tang, P. 2008). Uncertain market demand is an important environmental factor caused by concerns about who should pay (start-up costs, on-going costs, and long-term costs such as implementing and upgrading costs), and how much they should pay, an absence of data about user knowledge of, and demand for PHR systems, no data about its value for users, and a lack of data on how the workforce and processes will change in healthcare

institutions as a direct result of implementing PHRs (D. Detmer, Bloomrosen, M., Raymond, B., Tang, P. 2008).

Finally, the literature showed that workflow is another important environmental factor that impacts on PHR adoption (Nazi 2013). Workflow issues focus on the processes and procedures of work tasks through assigning specific roles for individuals to complete these work tasks. In healthcare, clinical workflow is described as how the specific task is done and by whom. If PHRs are intended to be integrated to enable the accomplishment of particular tasks, alignment with the workflow as a whole is necessary for it to be useful and effective for the healthcare team. In fact, medical and clinical workflow should be considered to optimize the usage of PHR into routine clinical practices. There are still concerns about PHR functions that are not suitable for real clinical workflows to cover needs of healthcare practitioners and patients (Nazi 2013).

2.4.2.3.6 Technological factors

The final category, technological factors, is composed of 11 factors: alternative strategies, interoperability, trialability, observability, availability, functionality, lack of access to the Internet, service quality, educational and technical support, EMR/EHR adoption, and customizability.

For example according to the literature, alternative tools and strategies can have negative impact on PHR adoption (M. D. Logue, Effken, J.A. 2013). Healthcare providers often apply alternative tools and resources in their tasks (Nazi 2013). For instance, although My HealtheVet (one of the most popular PHR systems) provides an important library of health education resources, healthcare providers would like to use alternative resources such as information from the Internet or subscription-based software that share information between health professionals.

Individuals claimed that using search engines on the Internet is an easy way to find out comprehensive information (Nazi 2013).

Additionally, the literature showed that interoperability is an important technological factor that impacts positively on PHR adoption (Butler 2013). It refers to capacity the of PHR systems to communicate with other health-related systems (EMR/EHR) and to connect healthcare providers with individuals through a shared information network (Lafky 2008). In order to decrease the amount of time that the individual requires during the initial set-up and data entry, PHR systems should be integrated with EMR/EHR systems; a few are. Moreover, it is helpful if PHRs connect with health devices such as blood pressure monitors, blood glucose monitors, and body weight monitors to improve healthcare decision-making procedures (Fernández-Alemán 2013).

In addition, the ability of individuals to have immediate access to their information seems to be a positive factor in PHR adoption according to the literature (Klein-Fedyshin 2002). Menon and colleagues (Menon 2012) claimed that 78% of the patients in their research wanted their information available on the Internet. In an emergency situation, 96% patients wanted doctors to have access to all their health-related information. In a life threatening emergency, individuals with multiple medical problems and life-threatening allergies were more likely to share information with doctors and wanted hospitals to retain their health-related information.

Another important technological issue based on the literature is functionality (Fuji 2014; Grossman 2009). There are various PHR functions related to health-related information including: weight, height, blood pressure, diabetes information, allergies, medication, immunizations, social history, emergency contacts, and family history. Also there are some functions that manage PHR consumer actions such as information sharing, adding, modifying, removing, and granting user

access. Moreover, some PHR functions focus on connecting with EMR systems, health devices, social networks, and third-party applications (Fernández-Alemán 2013). Incomplete functionality and data entry, data sharing, data validation, and information display methods applied by PHR systems limit patients to serve as suitable representations of health-related information. For instance, patients with diabetes need to have long-term monitoring and treatment (Andry 2009). They need to check their diet, exercise levels, and medication to avoid any complications. Therefore, navigation through a large amount of patient data is an important requirement. In such cases, if PHR systems provide interactive and easy to navigate functions, PHR users are more likely to adopt PHRs. Another important function is the ability of the PHR system to exchange data with EMR systems. With this function, physicians can download into their EMR system the information that individuals have entered in their PHRs, and can also send data about the individual from clinic records to that individual's PHR (Huba 2012).

2.4.2 Personally Controlled Electronic Health Record (PCEHR)

The National Health and Hospitals Reform Commission (NHHRC) suggested an individual-controlled electronic health record for each person in Australia to improve healthcare productivity and safety in 2009. Although it has been claimed that the Australia healthcare system is one of the greatest systems in the world, it has faced some challenges, such as medication errors, fragmented sources of health information, repetition in tests, increase in chronic illness, health workforce resource constraints and changing individuals' expectation with technology. These challenges led to Australian Government funding to start the development of a PCEHR system as a part of the national e-health strategy in 2010 (LeMay 2013).

At the first release of the PCEHR system (during 2010 to 2012), the Australian Government had investment about $467 million to develop the core infrastructure of the system. Finally, on July 1st 2012 the PCEHR started to register consumers. A key element of the PCEHR concept is providing a secure electronic health record infrastructure that places individuals at the center of their healthcare process, affording them access to their health data and the ability to monitor and manage its access to their providers and authorized users (S.-T. Liaw and Hannan 2010; Muhammad et al. 2012). Based on the National E-health Transition Authority (NEHTA) and the Australian Department of Health and Ageing (DOHA) the main objective of the PCEHR is "to address information fragmentation by allowing a person to more easily access their own health information and make their health information securely accessible to different healthcare providers involved in their care."((NEHTA 2013), page 11).

The PCEHR system is accessible from multiple sources. The system enables health providers, such as physicians, pharmacists and pathologists, to connect to it and exchange health information according to the set of standard specifications based on the Internet. The PCEHR can store clinical documents – such as health event summaries, pathology results, individuals' health histories – in the set of secure repositories (Showell 2011). Furthermore, individuals can share their health information with the healthcare providers and have access to medical information such as allergies information, over-the counter medications, and a child's immunization history.

According to the definition of PCEHR in the Department of Health and Ageing (DoHA) and National E-Health Transition Authority (NEHTA), the system involves information flow applying various clinical documents including: event summary (summary of major healthcare events of individuals linked to ongoing care), and discharge summary (including reports developed during the end of the healthcare organization's admission with treatment clarifications). The PCEHR

system is not a replacement for EMR/HER systems in the healthcare industry and PCEHR involves copies of the main source of health information and the original information remains in the local organizational records (Hambleton 2013). In fact, the PCEHR has faced various complexities and barriers during its journey, such as a limited number of health IT professionals, small IT vendor in the Australian market, political and economic situations, security and privacy concerns, time-consuming concerns, legal concerns, and a lack of individuals' awareness.

The PCEHR system has three major components including: provider portal, consumer portal, and clinical system integration. The first component of PCEHR is the provider portal, which helps healthcare professionals to view a shared health summary and add event summaries of their patients' health information (DOHA 2012; NEHTA 2013).

The second component of PCEHR is the consumer portal, which provides some features for individuals to use the system. The consumer portal has seven major sections that the researcher covered in our workshops:

Clinical Documents: This section consists of Diagnostic Imaging Reports, Pathology Reports, Shared Health Summary, and Discharge Summary. The Pathology and Diagnostic Imaging Reports can be used to share information about pathology tests and diagnostic imaging examinations via an individual's PCEHR. These reports include a PDF, which contains one or more examinations that are uploaded by the pathology or diagnostic imaging providers to the PCEHR. The Shared Health Summary is a clinical document written by a primary healthcare provider. It is a summary of an individual's health status at a single point in time and could include known allergies and adverse reactions, medications, medical history, and immunizations. Moreover, the PCEHR supports the collection of Discharge Summary documents. When a

healthcare provider creates a Discharge Summary document, it will be sent directly to the nominated primary healthcare provider, as per current practices. A copy can also be sent to the individual's PCEHR.

Medicine Records: This section consists of Prescription and Dispense Views. The Prescription view shows, in detail, the medications individuals have been prescribed, including the brand and ingredient names, the dose of the medication, and the directions for consumption. Similar information is also displayed in the view as their medications are dispensed.

Personal: This section consists of five major parts. The first part is Personal Health Notes. It is a consumer-only note and is an area of the individual eHealth record that allows individuals to store private notes about an individual's health. This can be considered an individuals' private health diary. Healthcare providers cannot view the Personal Health Notes. The second part is Personal Health Summary. It allows individuals to enter information about their own health and share it with their healthcare providers. This can include any allergies, adverse reactions experienced, or medications they might be taking. The third part is the Advance Care Directive Custodian. It is a written statement, which outlines wishes for an individual's future health and care. The Advance Care Directive Custodian is a person or organization that is the holder of individual's Advance Care Directive and may be contacted to produce the Advance Care Directive. The next part is Your Personal Details. This part shows an individual's details such as first name, last name, age, sex, address, contact number, etc. The healthcare providers will be able to see individuals' personal details, except their address and contact number. The last section is Emergency Contact Details, in which individuals can store details of people they would like contacted in a medical emergency.

Child Development: The Child Development function has been provided as a tool for parents to view and add information to their child's eHealth record. It provides useful information such as personal measurements for head circumference, height and weight, growth charts that allow parents to graph their child's development, information and reminders about immunizations, and information and reminders about child Health Checks.

Medicare Records: This section consists of information related to Medicare Benefits Schedule (MBS) information, Department of Veterans' Affairs (DVA) claims information, Pharmaceutical Benefits Scheme (PBS) information, Repatriation Pharmaceutical Benefits Scheme (RPBS) information, Australian Organ Donor Register (AODR) information, and Australian Childhood Immunization Register (ACIR).

Restricted Settings: Restricted Settings in the National eHealth record system allow individuals to have significant control over their eHealth record, including choosing who can access information in their eHealth record, setting controls on healthcare provider organization access, applying greater controls to sensitive information and choosing which information is not viewable through their eHealth record. By default, all healthcare providers involved in an individual's care are able to upload documents to their eHealth record, unless they specifically request providers not to.

Who Accessed My Record: The individuals are able to view details of every access made to their own eHealth record through an Access History.

The third component of PCEHR is clinical system integration. Healthcare providers can access to PCEHR with clinical systems which is complaint with the system such as Genie, Medtech32, practiX, and Zedmed softwares. Each software has specific features to apply the PCEHR system.

For example, healthcare professionals can use Genie software to get consents from consumers to access their health information, monitor individuals' PCEHR record, and update consumers' records and upload health/clinical documents (K. McDonald 2012).

2.5 Theories Concerning Technology Adoption

The main objective of this study is to assess the factors affecting EMR and PHR adoption. To guide the evaluation research it is essential to discuss a theoretical background. This section reviews the most important theories that help the researcher to evaluate factors impacting on technology adoption.

2.5.1 Theory of Reasoned Action

The theory of reasoned action was proposed by Fishbein and Ajzen in 1975 (Fishbein 1979). They claimed that behavioral intention determines particular behaviors of an individual to perform the actual behavior. Figure 2.16 shows the theory of reasoned action with its drivers for individual behavior.

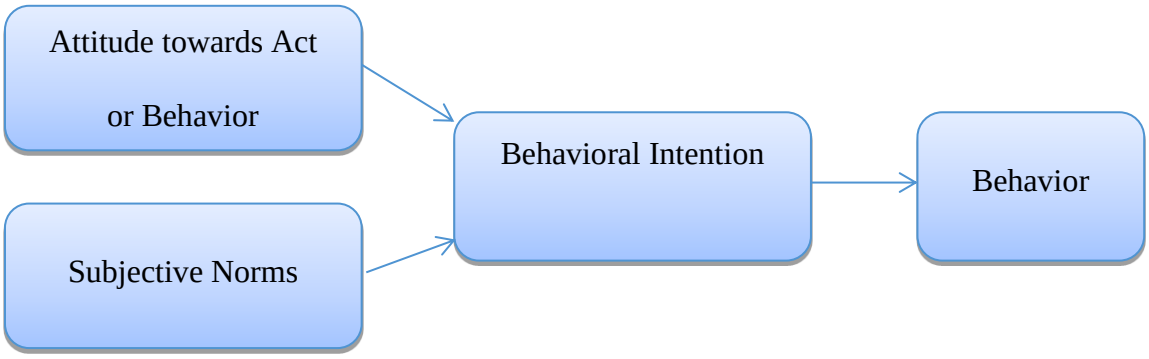


Figure 2.16 Theory of Reasoned Action

Source: (Fishbein 1979)

In this theory, the individual's attitude toward the behavior and subjective norms determine behavioral intention. Social norms are the perceived social influence to engage or not to engage in individual behavior and they are external factors, such as motivation to comply and the opinion of referent others that impact on the individual adoption process.

2.5.2 Theory of Planned Behavior

The theory of planned behavior is a theory of connection between belief, attitude, behavior, and behavioral intention (Armitage and Conner 2001). Figure 2.17 shows the theory of planned behavior. The main concept of this theory is based on the theory of reasoned action by adding perceived behavioral control.

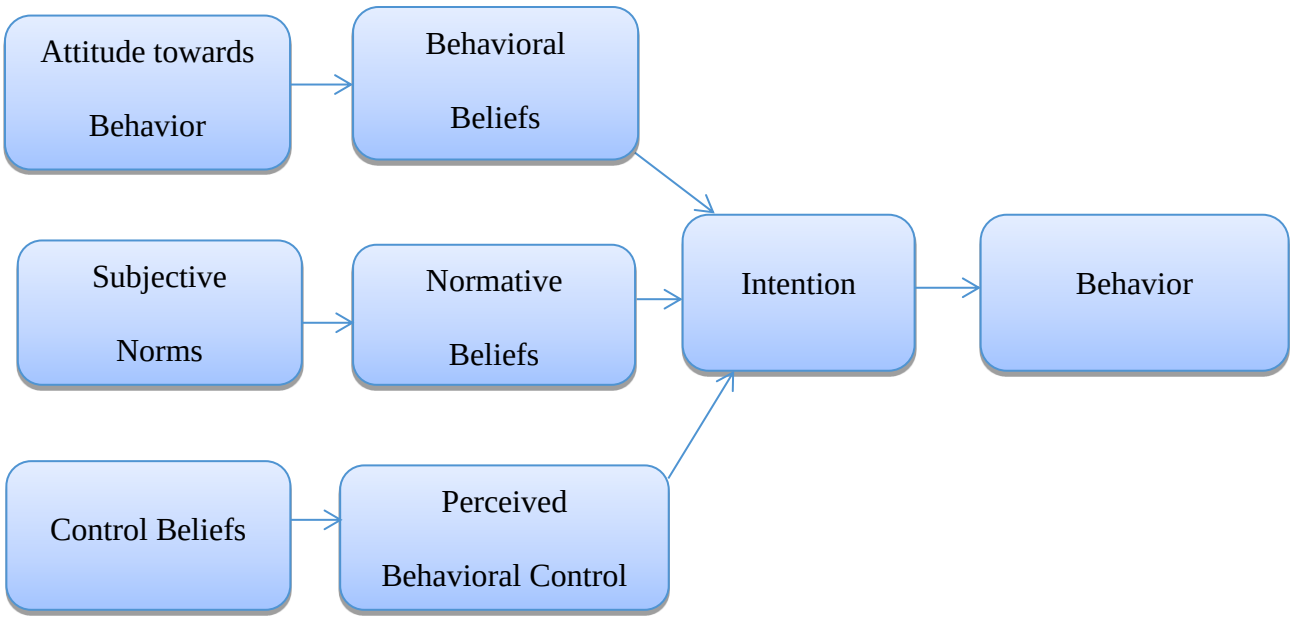


Figure 2.17 Theory of Planned Behavior

Source: (Armitage et al. 2001)

The main concepts that impact on individual behavior are behavioral beliefs (beliefs about the consequences or other attributes of the particular behavior), normative beliefs (beliefs about expectations of other people), and control beliefs (beliefs about the factors that can facilitate or impede performance of a particular behavior). As a matter of fact, behavioral beliefs result in a favorable or unfavorable attitude towards a particular behavior, and normative belief produces social pressure or external pressure (subjective norms), and finally control beliefs trigger perceived behavioral control. Perceived behavioral control focuses on the individual's perceptions of his/her ability to perform a particular behavior.

2.5.3 Technology Acceptance Model

One of the most important adoption theories in information systems is the technology acceptance model that focuses how individuals accept or reject a technology (Venkatesh and Davis 2000). This theory claims that there are some factors that impact on individuals' decisions to face new technology.

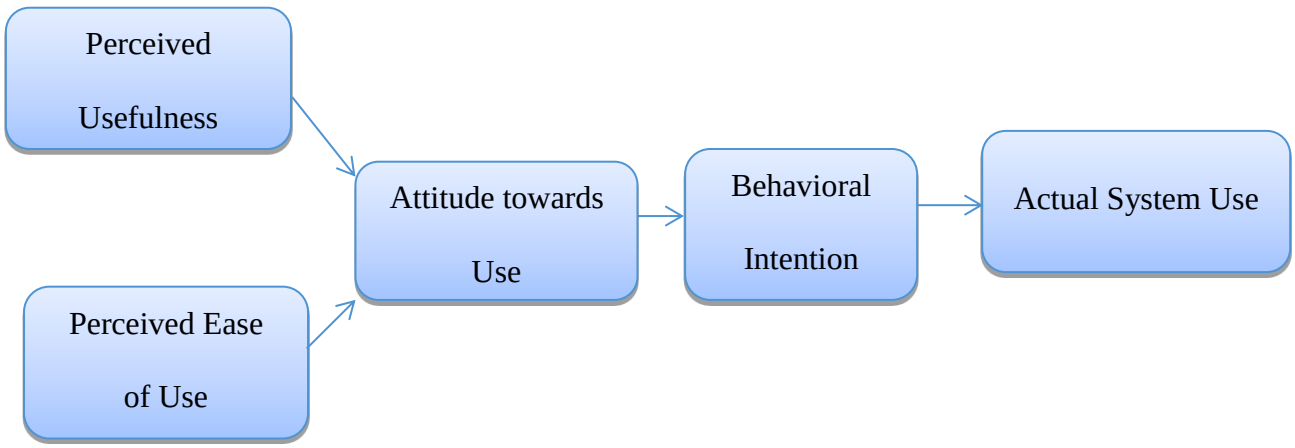


Figure 2.18 Technology Acceptance Model

Source: (Davis 1989)

The technology acceptance model has two major constructs that impact on attitude toward using particular technology. The first construct is perceived usefulness, which is defined by Fred Davis (1989) on page 320 of his paper as "the degree to which a person believes that using a particular system would enhance his or her job performance." The second construct is ease of use, which is defined as "the degree to which a person believes that using a particular system would be free from effort" ((Davis 1989), page 320). Figure 2.18 shows the technology acceptance model.

2.5.4 Individual and Family Self-Management Theory

This theory focuses on self-management behaviors to improve health outcomes (Ryan and Sawin 2009). It consists of three dimensions, namely: context, process, and outcomes. Context dimension focuses on risk and protective factors and includes individual and family characteristics, condition-specific factors (e.g. complexity of condition or treatment, physical transitions and trajectory), physical and social environment factors (e.g. social capital, culture, access to healthcare and transportation). The second dimension is a process that is based on self-regulation theories (Bandura 1991), theories of health behavior change (Glanz et al. 2008), social support theories (Shumaker and Brownell 1984; Vaux 1988), and studies related to self-management of chronic illnesses (Bodenheimer et al. 2002; Northern 2001). Based on these theories, if individuals develop their self-regulation abilities and also have social facilitations that support them, they can engage with health behaviors. Self-regulation consists of some elements such as decision-making, self-management behavior, self-evaluation of physical, emotional and cognitive changes, self-monitoring, and reflective thinking. The last dimension is an outcome that consists of a proximal outcome (connection between self-management behavior and specific to a condition) and a distal outcome (three categories: cost of health, quality of life or wellbeing, and health status). Figure 2.19 shows individual and family self-management theory.

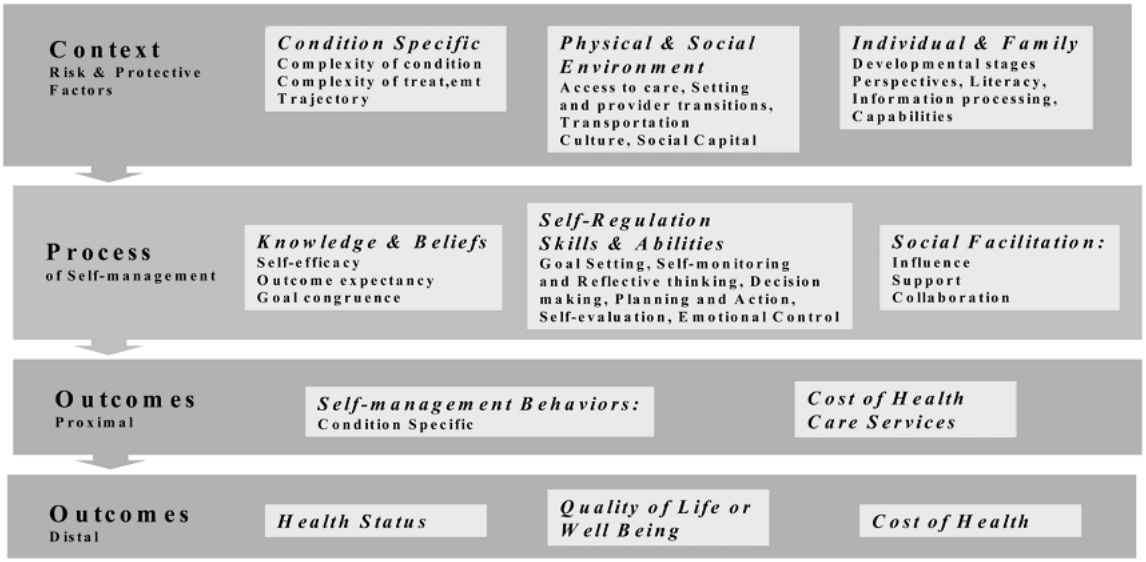


Figure 2.19 Model of the Individual and Family Self-management Theory

Source: (Ryan and Sawin 2009)

2.5.5 Health Belief Model (HBM)

The health belief model is one of the most important theories in health behavior and it is a psychological model, which tries to predict and clarify health behaviors (Rosenstock 1974). This model comes from health science and is based on the individual's understanding of having a health-related action. The HBM was initially proposed to predict the behavioral reaction of individuals with acute or chronic diseases to the treatment they receive (Glanz et al. 2008), but the model was later applied to predict more general health behavior (Ross et al. 2010; Semenza et al. 2011). The HBM is based on the understanding of individuals' perceptions of health-promoting behaviors (e.g. using condoms to avoid HIV (Rosenstock et al. 1994), self-screening to avoid breast cancer (Yarbrough and Braden 2001), using sunscreen to protect from skin cancer (Carmel et al. 1994), and conducting a self-management promotion education program to manage type 2

diabetes (Jalilian et al. 2014)). The HBM suggests that individual perceptions of health problems, perceived benefits of action and barriers to action, self-efficacy and cues to action explain engagement (or lack of engagement) in health-promoting behavior. In this study, the researcher assessed the role of the PCEHR as a health-related action to support health-promoting behavior (self-management of chronic conditions).

The HBM has six main components, which are: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy. Perceived susceptibility or perceived risk refers to the subjective evaluation of the risk of evolving a health problem. According to the HBM, if individuals are susceptible to a specific health problem, they try to have healthy behavior to decrease the risk of that problem. Perceived seriousness or perceived severity refers to the subjective evaluation of the severity of a health-related problem and its possible effects. Individuals are more likely to have healthy behavior if they perceive a particular health problem as serious. Perceived benefits refer to possible benefits of health-promoting behavior to reduce the risk of the health problem. For instance, individuals who believe that using condoms prevents HIV are more likely to use a condom than individuals who believe that using a condom will not prevent HIV (Janz and Becker 1984). Perceived barriers refer to possible barriers and difficulties to behavior change and health-promoting behavior. Cues to action refer to internal or external triggers to perform a particular health behavior. For instance, cues to action can be the information from the media, friends, family member, and advertisements. Self-efficacy refers to the individual's ability to perform a healthy behavior. Finally, in the HBM there are some modifying variables, such as demographic, psychological and structural factors that affect perceptions of health-related behavior (Rosenstock et al. 1988; Rosenstock 1990). If an individual perceives a larger health threat (perceived susceptibility and severity), as well as more benefits in

acting and fewer barriers while engaging in preventive healthy action, greater self-efficacy to take action, and greater cues to action, then the likelihood of this individual performing health-promoting behavior becomes greater (Ahadzadeh et al. 2015; Yarbrough and Braden 2001). Figure 2.20 shows the health belief model.

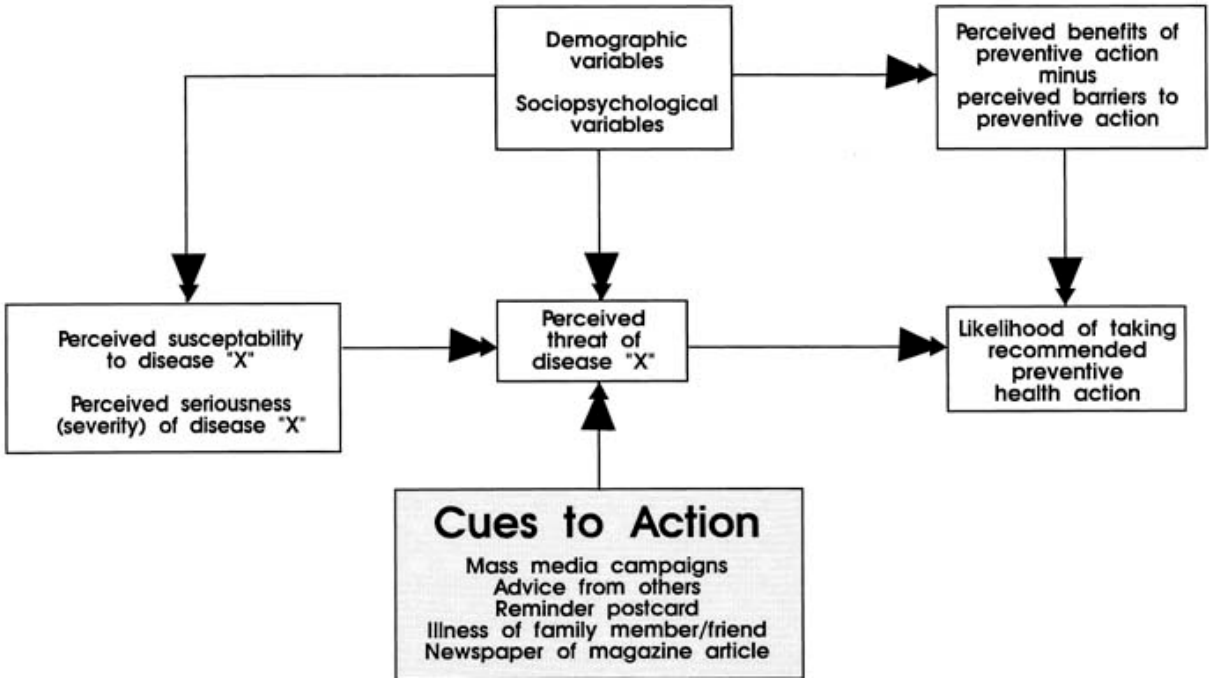


Figure 1.20 Health Belief Model

Source: (Rosenstock 1974)

2.6 Research Gaps in EMR and PHR Literature

Although there have been different studies on EMR and PHR adoption, the majority of these studies have concentrated on defining implementation success factors, barriers and potential effects of the system use in healthcare (Simon et al. 2007). For example, lack of efficiency, lack

of training, complexity of the system, lack of user confidence and lack of perceived usefulness are the major problems that lead to underuse of EMR systems (Holden 2011). Moreover, most of the studies have concentrated on outpatient settings and primary care health providers (Jha et al. 2009; Jha et al. 2010). None of the research has provided a comprehensive adoption model that leads to actual system use, so it makes studying this part of EMR research a valuable addition to the body of knowledge. Furthermore, in terms of the PCEHR system, there have been no studies regarding the adoption of PCEHR as Australia's PHR system to provide a comprehensive model of barriers and facilitators of the system's acceptance.

The main research question that will help achieve the objective of this research by filling the above-mentioned gaps in the literature is as follows:

What are the facilitators and barriers involved with the adoption of electronic medical records used by healthcare providers and personal medical records used by individuals?

In order to make a clear research question, the researcher divided this research into two sections.

RQ1. What are the facilitators and barriers involved with EMR adoption by healthcare providers?

RQ2. What are the facilitators and barriers involved with PHR adoption by individuals?

Therefore, if users are to benefit from the use of EMR and PHR systems, it is crucial to understand the factors affecting their user adoption. As the researcher discussed earlier, this research consists of two studies to discover facilitators of and barriers to EMR and PCEHR as Australia's National PHR system. The first study focuses on the EMR system that mainly involves

health providers, such as physicians, nurses and clinicians. The second study concentrates on the PHR system that specifically works in the PCEHR system, which involves Australian people to monitor and manage their health information.

2.7 Summary

First of all this chapter provided some background information about EMR systems, including EMR definitions, EMR benefits in healthcare, recent research areas in EMR literature, and EMR adoption issues. Then the PHR system was described and the researcher provided a good understanding of PHR definitions, PHR adoption, and finally the Australian National PHR system (PCEHR). Moreover the researcher has discussed theories concerning the adoption of technology, including the theory of reasoned action, the theory of planned behavior, the technology acceptance model, individual and family self-management theory, and health belief model.

In this chapter the researcher provides two significant research contributions. Firstly, the researcher has undertaken a literature survey to provide a taxonomy that represents research areas of EMR. He identified the following areas of research and classified them into eight main categories: design and implementation, evaluation, adoption, impacts, medical research, integration, EMR data design and management, and policy and standards. Even though EMR improves care quality and efficiency in a positive way, some negative perceptions by the healthcare user community (health professionals and health service managers) should not be neglected. By categorizing EMR research articles, the researcher has revealed a clear set of major challenges for EMR in the future education and research in health informatics, biomedical engineering and related areas. A bigger picture of EMR research areas presented in this study helps the health community to find scientific methods for the various major challenges in EMR.

The second contribution of this section was the conducting of the literature survey to propose a reflective pause on the adoption of health information technology literature in order to broaden the understanding of factors contributing to the user adoption. The researcher has provided a comprehensive taxonomy of the factors influencing the user adoption of EMR and to classify these factors into meaningful categories. The effectiveness of adoption theories has been explored, based on the empirical results identified in the EMR research. Furthermore, according to the conceptualization of the factors in the literature, a list of 78 factors affecting EMR adoption was identified. These factors were classified into eight categories: individual factors; psychological factors; behavioral factors; environmental factors; organizational factors; financial factors; legal factors; and technical factors. Finally, the results have implications for researchers and practitioners, including policymakers, marketers, IT professionals, HIM practitioners, health practice managers, and EMR system developers.

According to the nature of the EMRs that are applied by healthcare professionals, most of the user adoption factors were related to the organizational and environmental factors, such as geographic location of healthcare organizations, competition, vendor effort, reputation of the practice, ownership and social norms. On the other hand, PHR systems interact with individuals to manage their health information. The majority of factors affecting PHR adoption are psychological and individual factors, such as age, gender, marital status, employment status, self-efficacy, trust in the system, perceived ease of use, and perceived usefulness.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Overview

Chapter 3 aims to outline the research methodology chosen to fulfill the objectives of this study. This research consists of two studies to enable the determination of facilitators and barriers to EMR and PHR systems from the perspectives of both staff and customer users. The first study focuses on the EMR system and involves health providers, such as physicians, nurses and clinicians. The second study concentrates on the PCEHR system which is Australia's National PHR system and mainly involves individuals, such as patients, to own and manage their information within the system. The main advantage of this research is that it covers all end users of e-health systems. Chapter Three begins with clarifying the qualitative and quantitative research approach. The chapter continues by explaining the research approach that was employed for the EMR section of the study. Finally, the researcher clarifies the research methodology that was

applied to evaluate factors impacting on the user adoption of the PCEHR. Figure 3.1 graphically demonstrates the outline of Chapter Three.

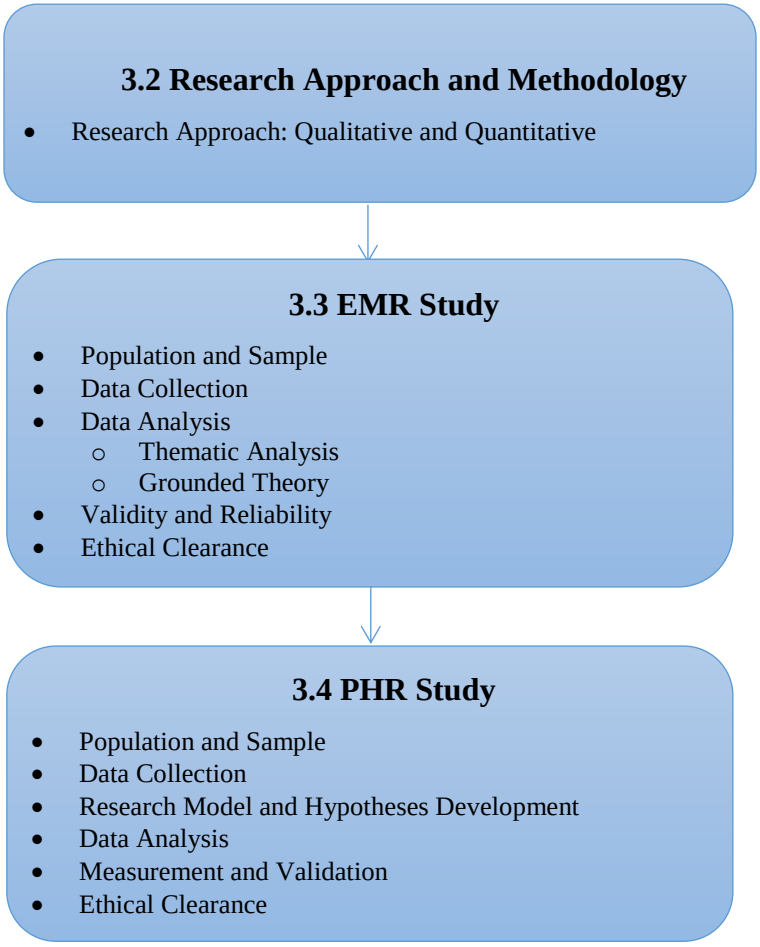


Figure 3.1 The outline of chapter three

3.2 Research Approach and Methodology

Quantitative and qualitative methods are two major approaches applied in academic research (Creswell 2005). The quantitative approach refers to "educational research, in which the researcher decides what to study, asks specific narrow questions, collects numeric (numbered) data from participants, analyzes these numbers using statistics, and conducts the inquiry in an unbiased, objective manner" (Creswell 2005: 39). The main aim of the quantitative research method is to design and develop mathematical models, theories and hypotheses. Researchers using the quantitative method to try to find the relationship between independent variables and dependant variables in the research.

On the other hand, the qualitative research approach tries to achieve a complete understanding of a particular event, rather than a superficial explanation of a huge sample of a population (Creswell 2005). There are five main approaches to qualitative study: narrative research, case studies, grounded theory, ethnography, and phenomenology (Cooper and Schindler 2003). In the narrative study, the researchers try to find the meaning of participants' lives from narrative linked to history, drama, and folklore. Case studies are based on particular events relating to individuals rather than a group of people. A grounded theory approach tries to uncover new theory inherent in the data derived from the research. An ethnographic research design focuses on description, analysis, and interpretation of cultural phenomena according to knowledge, beliefs, and language. The phenomenological approach is a qualitative research approach and it is based on empirical observation of a particular phenomenon.

3.3 EMR Study

Although some interesting cases have been reported (Ochieng and Hosoi 2006; Park et al. 2012; Randeree 2007), the current literature does not yet provide sufficient insight to explore the adoption of EMRs by healthcare providers in hospitals. The aim of this section of the study was to gain an in-depth understanding of the barriers and facilitators to the adoption of EMRs by their users and the author applied an exploratory case study approach in order to generate an in-depth understanding of EMR adoption in a real-life context. According to Yin (2013), case studies can be used to explore, explain or describe events or phenomena in the everyday contexts in which they occur. This statement emphasizes that an important strength of case studies is the ability to undertake an investigation into a phenomenon in its context; it is not necessary to replicate the phenomenon in a laboratory or experimental setting in order to better understand the phenomenon. Case studies are thus a valuable way of looking at the world around us (Neuman 2005). The exploratory case study is a research approach applied to exploring a contemporary phenomenon that is inseparable from the context in which it exists (Rowley 2002).

This kind of approach is suitable for addressing "what", "how", and "why" type questions. In this part of study, the researcher investigated the nature of the healthcare professionals' experience of EMR use by addressing these research questions: What are the facilitators involved in EMR adoption by healthcare providers? What are the barriers involved in EMR adoption by healthcare providers? An exploratory case study approach suited this study because it asked "what" questions and was based on a key assumption that the phenomenon is inseparable from the context in which it exists. The researcher feel that exploratory research is essential in order to provide a set of meaningful adoption factors to be empirically validated in future research.

3.3.1 Population and Sample

The researcher contacted the principal project managers and EMR information managers of the Gold Coast University Hospital (GCUH) and Royal Brisbane & Women's Hospital (RBWH). The EMR was one of the essential system in these hospitals and also their management department were eager to find out the factors impacting on their system adoption. They agreed to provide an initial list of EMR users in different departments of the hospitals. Furthermore, the EMR information managers agreed to randomly contact initial respondents (from different departments) to identify their interest in participating in the interview. Table 3.1 shows the summary of demographic information for the participants in the GCUH and the RBWH.

Table 3.1 Participant demographic summary

Gold Coast University Hospital (GCUH)	Age	
	30–40	15%
	41–50	35%
	>50	50%
	Gender	
	Male	37%
	Female	63%
	Educational level	
	Associate's degree	13%
	Bachelor's degree	41%
	Master's degree	11%
	Doctorate	9%
	Other	26%
Royal Brisbane and Women's Hospital (RBWH)	Age	
	30–40	9%
	41–50	59%
	>50	32%
	Gender	
	Male	41%
	Female	59%
	Education	
	Associate's degree	16%
	Bachelor's degree	34%
	Master's degree	28%
	Doctorate	3%
	Other	19%

Once the initial list of interviewees was identified, the researcher scheduled the interviews at an agreed time and date and they provided introductory information and the informed consent forms before the day of the interview.

The participants were asked to read all information related to this research and sign the informed consent form, which they returned to the researcher on the interview date. On the interview day, the researcher repeated the objective of the research to the participants and turned on the digital voice recorder to record the interviewee responses.

After completing the questions, the respondents were asked to nominate other potential EMR users, a tactic based on the snowball sampling approach. The sample for this part of the study was chosen using snowball sampling (Biernacki and Waldorf 1981). Snowball sampling is a non-probability sampling technique where the sample group grows in each step of the data collection like a rolling snowball. Principal project managers were asked to provide an initial list of EMR users (initial pool) in different departments. After that, the researchers used snowball sampling and asked initial participants to nominate other potential EMR users.

The initial intent of this research was to interview a wide range of healthcare providers; however, after 46 healthcare professional interviews, the research appeared to reach saturation, with no new open codes in GCUH. The researcher then conducted five more interviews to ensure that he had reached saturation in GCUH. As can be seen in Figure 3.2, there were no new open codes in the transcripts in interviews 47 to 51. After analyzing the transcripts several times the researcher was unable to find new information or codes in the data and, in accordance with the investigation related to data saturation in qualitative research (Guest et al. 2006; Mason 2010), concluded that data saturation had been reached. The researcher therefore selected another large

hospital with the same EMR infrastructure and with the same status in order to obtain new information. The initial target of interviews in the RBWH was a wide range of practitioners, but after 32 interviews the study appeared to reach saturation with no new information related to EMRs. The researcher conducted five more interviews to ensure that he had reached saturation in RBWH. Figure 3.2 shows that there were not any new open codes in interviews 33 to 37 in RBWH, and that the researcher had reached data saturation in this hospital. Finally, the researcher had time and resource limitations that prevented us from focusing on new hospitals with comprehensive EMR systems.

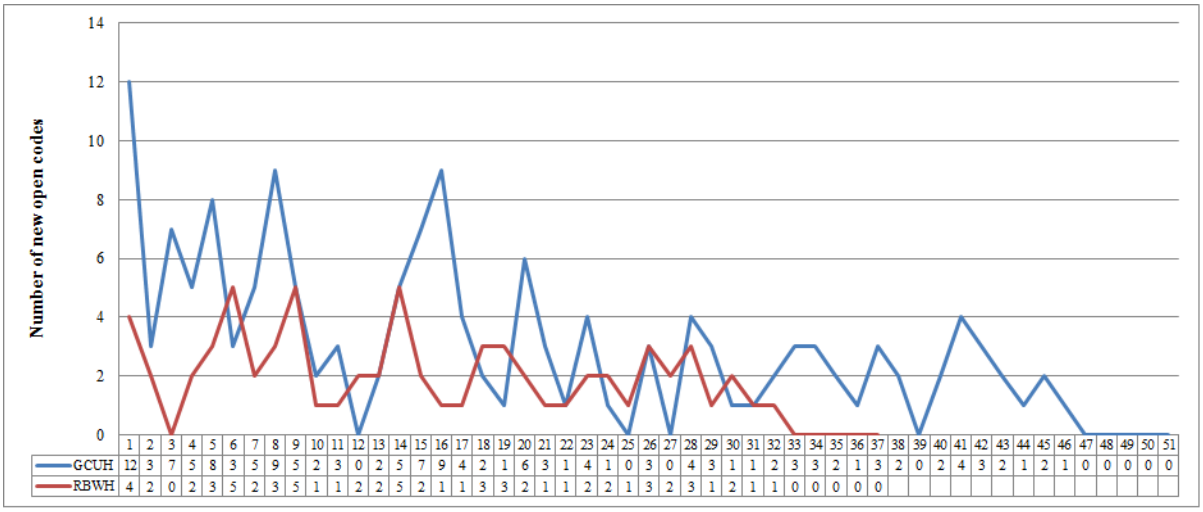


Figure 3.2 The number of new open codes in each interview

3.3.2 Data Collection

Interviews and observation are two major methods of collecting qualitative data as part of research. There are some advantages of observation over conducting interviews (Neuman 2005).

I) Much closer to participant's culture as a participant

II) Prolonged immersion lends itself to better understanding

III) Seeing things that people would not talk about (in the interview, people are telling you what they think, which is not necessarily the same as what they do)

IV) Time spent increases the ability to situate action in context

Conducting interviews has some benefits compared to conducting observation in research, however (Neuman 2005).

I) Some things are difficult to see, so must be asked about

II) Interviewing allows researchers insight into times when they were not present

III) Easier to understand for participants/subjects than observation

IV) Interviewing allows researchers to find a broader cross-section of people

V) When a topic is identified, interviews can be more focused than waiting for an appropriate observation

In this section of the study, semi-structured and open-ended interviews were the main data source and were applied in order to understand and obtain insights into factors that impact EMR adoption. Participants were asked open-ended questions about their real experience with EMRs and the obstacles faced during interaction with them. The researchers also asked demographic questions to collect participant demographic information.

The list of targeted interviewees included the principal project managers, EMR information management, information technology operations managers, the senior information technology staff involved in implementing, testing, deploying or monitoring aspects of the EMR system, and EMR end users such as physicians and nurses. There were 78 interviews conducted between August 2013 and September 2014 with a total of 15 different kinds of participants (see demographic data in the results section) in the GCUH and the RBWH.

The major objective of this study was to identify the experience of healthcare professionals when using the EMR system. According to the literature (Neuman 2005), the more unstructured the interview, the more the quality of information obtained during an interview is dependent on the interviewer and can be influenced by the interviewer's own views. Therefore, the researcher applied semi-structured and open-ended interviews and tried to avoid any reflection of their own identity and experience on interviewees. Before starting the interviews, the researcher presented all interview questions to the principal health managers of the hospitals to avoid any bias in the questions (Appendix A). According to the managers, all questions were easy to understand, did not include a presupposition, and were applicable to the healthcare providers. The researcher did not have any role in the hospitals and did not have any experience with the EMR system that could interfere with the healthcare professionals' experience with the system. Rather than tying what participants said into the latticework of the researcher's own beliefs, the researcher tried to hear healthcare professionals on their own terms, to conceive of different paradigms, to judge views that could differ from the researcher's own beliefs as valid, consistent or worth subscribing or switching to.

3.3.3 Data Analysis

After completing the interviews, the researcher transcribed the interview responses into the NVivo software (Gibbs 2002). This software is useful software for collecting, organizing and analyzing data from qualitative and mixed methods research. It has been used to manage data from interviews and focus group discussions. In the transcribing process, the respondents' name will not be included in the transcriptions to increase confidentiality and anonymity. The interviewees were assigned a random numerical code.

To analyze collected qualitative data, the researcher used two common data analysis approaches (thematic analysis and grounded theory) to gain an in-depth understanding of the barriers to and facilitators of the adoption of the EMR system by its users.

3.3.3.1 Thematic Analysis

This part of the study used thematic analysis to analyze qualitative data. Thematic analysis is one of the most popular approaches in qualitative studies (Boyatzis 1998; Braun and Clarke 2006). This analysis approach is based on patterns / themes across the set of data. There are six major phases applied for qualitative analysis (see Figure 3.3).

Figure 3.3 Data analysis process

The following are the six phases of data analysis:

I) **Familiarization with the data:** The researcher will read and reread data and start to think about main variables affecting EMR adoption based on the nouns, verbs, adjectives and adverbs in the interviewees' responses.

II) **Coding:** The researcher will generate concise labels (initial codes) that show major features of the data based on the research questions. This phase might be conducted several times, adding, deleting, combining, or splitting potential labels/codes. Additionally, the researcher will provide inferences about the understanding of each code. At the end of this step, data is broken down into potential categories and is then ready for the next level of analysis.

III) **Searching for themes:** In this phase the researcher will examine the codes and the interview transcripts to identifying major wide-ranging patterns of meaning or potential themes. Themes consist of phrases or sentences that clarify the data meaning.

IV) **Reviewing themes:** The researcher will check the candidate themes with the interview transcripts to identify which themes support or refute the objectives of the study. Therefore, the initial set of themes can be split, combined or discarded in this phase.

V) **Defining and naming themes:** In this phase, the researcher will provide a detailed analysis of each theme and identify a full story of them and its importance in answering the research questions.

VI) **Writing up:** The researcher will start the process of writing the final report of analysis after reviewing the final themes. This phase provides straightforward and clear data according to the theme classification used.

3.3.3.2 Grounded Theory

Grounded theory is a research approach that concentrates on developing theory from the qualitative analysis of data without any specific commitment at the outset to any specific kinds of

data, lines of research or theoretical interests (Strauss and Corbin 1990). In accordance with the grounded theory approach, the data analysis was performed in three major phases. In the first phase (open coding), the researcher read all transcripts several times and assigned a code to each phrase. The open codes were generated from the data itself, applying a line-by-line coding strategy. This approach helps to identify gaps, define actions and explicate both actions and meanings and leads to developing theoretical clusters. This stage takes time to review all codes and he merged or deleted some codes based on their concepts and meanings. In the second phase (axial coding), he attempted to make relationships and links between open codes. The researcher categorized all codes according to their meanings. Finally, in the last phase, as a selective coding, he linked all categories/themes and selected a focal core theme. The researcher explained the relationship of other themes with this central theme and proposed the storyline based on the core theme. This is the last phase of grounded theory leading to the development of a final theory. All other themes were related back to the core theme. With the core theme as the key idea, a single storyline was developed around which all other information was arranged. Figure 3.4 shows the details of the three main phases of data analysis.

3.3.4 Validity and Reliability

The interview questions have been made by expanding the research questions into a group of questions to achieve the research objectives. Sequence, content and ethical issues are the main important construction of interview questions. According to Neuman (2005), no questions should be constraining or leading (they should be neutral and open-ended), they should be designed to ask one thing at a time, and the interviewer should be specific in each question, should apply language familiar to the interviewee and be impartial in tone.

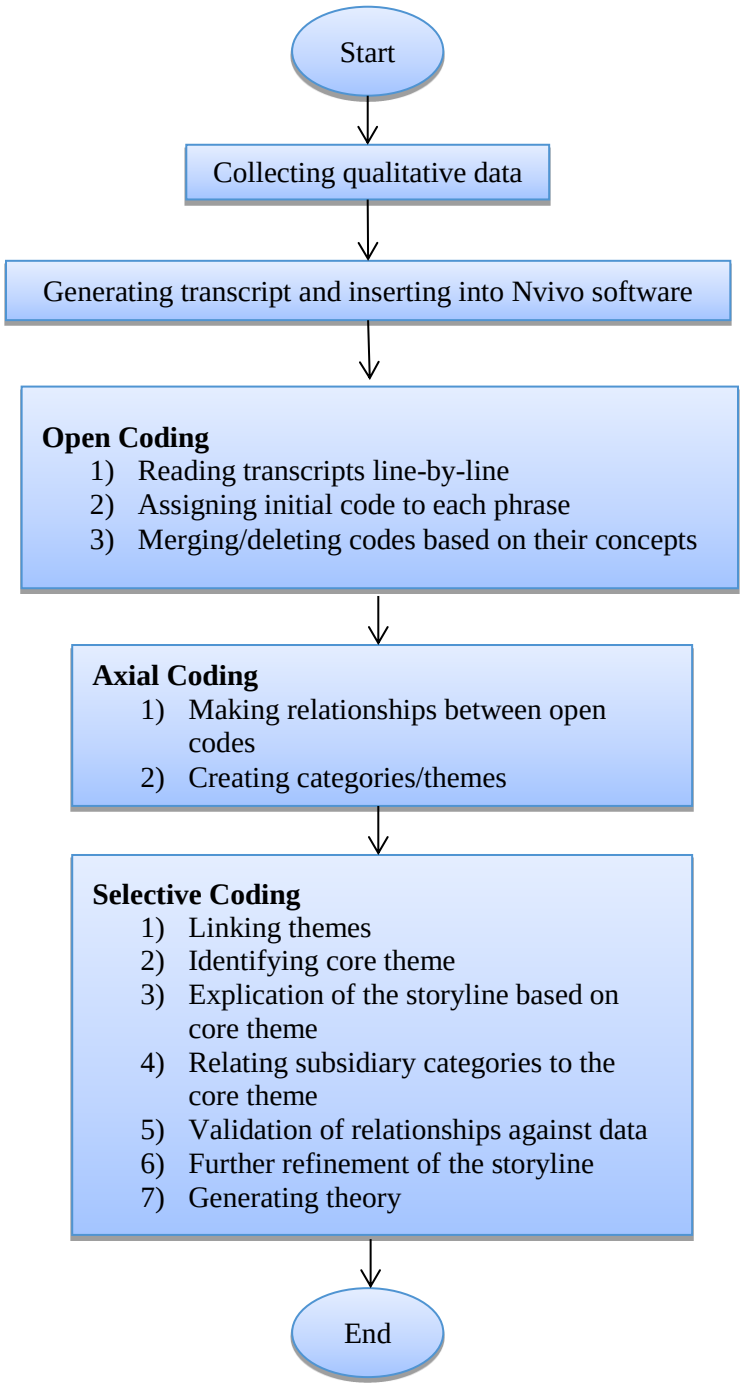


Figure 3.4 Phases of data analysis

Furthermore, the sequence of the questions should be started from easy and non-controversial questions, and continue with general to specific questions. Finally, the validity and reliability of interview questions are the key issues in the qualitative interview.

The researcher devised open-ended interview questions based on the research questions to minimize the potential of research bias. Furthermore, the researcher conducted an expert panel review to ensure the interview questions support the specific research questions in this part of the research and bolster the validity and reliability of the qualitative research studies (Maxwell 2012). Prior to implementing the interview questions, five professionals in the field of health informatics were contacted via e-mail to assess the interview questions for this case study; however, only three responded.

The researcher asked the panel experts to make recommendations to increase the researcher's capability of answering the research questions. One expert noted that a question should be added in the demographic information to ask "What is your highest level of education?" One expert stated that the questions "If any problem occurs, what steps do you take to identify and resolve the problem?" and "Do you follow any particular procedure when confronted with the problem?" were the same, therefore one of the questions was removed. Furthermore, one of the experts suggested adding a question related to the participants' expectation from their hospital to improve the use of the EMR system. The researcher added "What do you expect most from your hospital to improve the existing EMR system?" Finally, the researcher evaluated the results of the expert panel review procedure and achieved a final set of interview questions (Appendix A).

3.3.5 Ethical Clearance

The researcher provided a summary of the project and presented this to participants before starting the interviews (Table 3.2). He issued an informed consent form, which covered the objectives, scope, and nature of the project, and the expected benefit or potential harm that may come from participation (Appendix B).

Table 3.2 Approved research ethics

Hospital	Griffith Ethics Reference Number	Queensland Health Ethics Reference Number
Gold Coast University Hospital (GCUH)	**ICT/09/13/HREC** Start Date: 25 August 2013 End Date: (Extension requested) 31 December 2013 **ICT/09/14/HREC** Start Date: 15 June 2014 End Date: 31 December 2014	**HREC/13/QGC/113** Start Date: 24 October 2013 End Date:24 October 2016
Royal Brisbane and Woman's Hospital (RBWH)	**ICT/09/14/HREC** Start Date: 15 June 2014 End Date: 31 December 2014	**HREC/13/QGC/113/AM01** Start Date: 16 September 2014 End Date:24 October 2016

Participants understood the nature of the research and knew that their participation was voluntary and they could withdraw from the study at any time without penalty. They understood that there were no direct benefits in this research. The participants were asked a series of questions about the EMR system and they were not required to answer every single question. The interviewees could pass on any question that made them feel uncomfortable. Participants were informed that the interview data would be used as a part of a PhD study in the future, but that it would not include any identifying information about the participants. Furthermore, they were told that transcriptions would be kept for five years after the close of the research. This part of the research has been approved by Griffith University Human Research Ethics Committee and Queensland Human Research Ethics Committee.

3.4 PHR Study

To date, evaluating the role of PHR systems (PCEHR) in order to support individuals' self-management behaviors and maximize their uptake remains unclear. In particular, there has been little explanation from the 'elderly's perspective as to how PHRs can support them to manage their chronic conditions (N Archer et al. 2011; Bourgeois et al. 2008). The aim of this section of the study was to aims to discover the relationships between individuals' health-promoting behaviors and PHR adoption.

3.4.1 Population and Sample

The population was selected from members of the University of the Third Age (U3A), which is a nonprofit incorporated association on the Gold Coast in Australia. The U3A provides socializing, learning, and tutoring for mature people aged over 50 years (Swindell et al. 2011). Purposive sampling has been applied in the PHR study, because the researcher wanted to access a

particular subset of people. It started with a purpose in mind and the sample is hence selected to include people of interest and exclude those who do not suit the purpose. First, the researcher sent an invitation email to almost 400 seniors in the U3A and encouraged them to participate in the PCEHR workshops. The researcher asked them to attend the eight-week workshops if they met the following criteria:

I) They had a confirmed diagnosis of a chronic illness or were affected by chronic pain

II) They were not registered in the PCEHR system

III) They had a basic computer and Internet knowledge

One hundred and seven seniors met the selection criteria and successfully registered in the program. The researcher invited them to attend a U3A seminar room to have a chat about their chronic condition and receive a brief explanation of the self-management program. On that day, the researcher explained the advantages of the self-care program in chronic disease conditions and motivated them to continue in this study. Because of some resource limitations (computer and the Internet), the researcher randomly divided participants into two different groups. The first 53 seniors attended from January and February 2015 and the next 54 seniors attended from April and May 2015.

In the first session of the workshop, the researcher explained the advantages of a self-care program in chronic disease conditions and motivated participants to continue in this study. He provided a booklet that contained all the content in the program (an overview of activities). He organized two hours of interactive workshops and assisted participants in managing their health-related information in the PCEHR. First, the researcher taught participants in the intervention

group how to register and log in to the system. Each week, they read the week's content from the booklet, logged in to the PCEHR and completed that particular activity. For example, he taught the participants to add information related to their condition in Personal Health Notes as a private message for their own reference. Moreover, the individuals were taught to share their own health conditions, such as any allergies and adverse reactions experienced, with their healthcare providers by using the Personal Health Summary section. The researcher encouraged all participants to motivate their healthcare providers, such as their local general practitioner, to upload clinical documents, diagnostic imaging reports, and pathology reports.

3.4.2 Data Collection

After completing eight weeks of workshops, the researcher asked all participants to complete the survey to evaluate the factors impacting the individuals' intention toward the PCEHR, based on the Health Belief Model (HBM). Those who completed the survey were given a small valuable gift as a token of the appreciation. He administered a survey to the 107 seniors who attended all PCEHR workshops.

The HBM was initially proposed to predict the behavioral reaction of individuals with acute or chronic diseases with regards to the treatment they receive (Glanz et al. 2008), but the model was later applied to predict more general health behavior (Ross et al. 2010; Semenza et al. 2011). The HBM is based on the understanding of individuals' perceptions of health-promoting behaviors (i.e. using condoms to avoid HIV (Rosenstock et al. 1994), self-screening to avoid breast cancer (Yarbrough and Braden 2001), using sunscreen to protect against skin cancer (Carmel et al. 1994), and conducting a self-management promotion education program to manage type 2 diabetes (Jalilian et al. 2014)). The HBM suggests that individual perceptions of health problems, perceived

benefits of action and barriers to action, self-efficacy, and cues to action explain engagement (or lack of engagement) in health-promoting behavior. In this study, we assessed the role of the PCEHR as a health-related action to support health-promoting behavior (self-management of chronic conditions).

According to the HBM (Jalilian et al. 2014), the self-management of chronic conditions can be assessed based on six major constructs: perceived susceptibility, perceived severity, perceived usefulness, perceived barriers, perceived self-efficacy, and cues to action. The first construct is perceived susceptibility (perceived risk), which refers to an individual's perception of the risk or the chances of contracting a health disease or condition. Next, perceived severity (seriousness) is identified as the degree to which individuals think a specific disease or condition is serious. The third construct is perceived usefulness, which refers to individuals' evaluations of the value or efficacy of engaging in health-promoting behavior to reduce the risk of a health condition. Next, perceived barriers refers to an individual's evaluation of the obstacles to behavior change. The fifth construct is perceived self-efficacy, which refers to an individual's perception of his or her ability to successfully complete a specific task (behavior change). Finally, cues to action are the stimuli necessary to trigger the decision-making process to accept taking a recommended health action.

If an individual perceives a larger health threat (perceived susceptibility and severity), as well as more benefits than barrier while engaging in preventive healthy action, greater self-efficacy in taking action, and greater cues to action, then the likelihood of this individual taking health-promoting behavior becomes greater (Ahadzadeh et al. 2015; Yarbrough and Braden 2001). In accordance with the literature (Ghaffari et al. 2012; Jalilian et al. 2014; Kazemi et al. 2012), all the HBM constructs test individually to evaluate the impact of each HBM construct as an outcome

variable of engagement in health-promoting behaviors. Outcome measures were collected from both groups at baseline (pretest) and at the end of the workshop in week eight, using a survey. The questionnaire had two main parts with 37 questions. The first part gathered the demographic data of the participants. The second part of the survey focused on the main constructs in the HBM that we measured in this section. The questions regarding HBM constructs were designed applying a five-point Likert scale (ranging from "strongly agree" to "strongly disagree").

3.4.3 Research Model and Hypotheses Development

This study adopts the HBM as a research framework for investigating usage intention regarding the PCEHR. Intentions to perform particular behaviors have been proven to be the most influential psychological predictors of actual behaviors (Armitage and Conner 2001; Godin and Kok 1996). Some previous research studies have also selected intention instead of actual usage as a dependent variable to investigate information technology acceptance by physicians (Hung et al. 2012; Mun et al. 2006).

The HBM was initially proposed to predict the behavioral reaction of individuals with acute or chronic diseases to the treatment they receive (Glanz et al. 2008), but the model was later applied to predict more general health behavior (Ross et al. 2010; Semenza et al. 2011). The HBM is based on the understanding of individuals' perceptions of health-promoting behaviors, i.e. using condoms to avoid HIV (Rosenstock et al. 1994), self-screening to avoid breast cancer (Yarbrough and Braden 2001), using sunscreen to protect against skin cancer (Carmel et al. 1994), and conducting a self-management promotion education program to manage type 2 diabetes (Jalilian et al. 2014). The HBM suggests that individual perceptions of health problems, perceived benefits

of action and barriers to action, self-efficacy, and cues to action explain engagement (or lack of engagement) in health-promoting behavior.

The research closely follows this model, as the HBM has been one of the most widely cited psychological health behavior change models developed to explain and predict health-related behaviors, particularly with regard to the uptake of health services (Ahadzadeh et al. 2015; Yue et al. 2015). The researcher applied the HBM to evaluate usage intention towards using the PCEHR as a health-related action to improve chronic conditions. According to the HBM, individuals must value their health and expect that certain health-related action (using the PCEHR to manage their health) will help them avoid illness and/or achieve good health.

There are six basic constructs of the model that will predict whether individuals will adopt any health-related actions: perceived usefulness; perceived barriers; cues to action; perceived susceptibility; perceived severity, and perceived confidence. The researcher posits seven different hypotheses and the research model is shown in Figure 3.5. The hypotheses are developed in detail below.

Perceived susceptibility can be defined as an individual's perception of the risk (or the chances) of contracting a health disease or condition (Frankenfield 2009; Rosenstock 1990). According to the HBM, individuals who perceive a high risk of being personally affected by a particular health problem are more likely to engage in behaviors that decrease their risk of developing the condition (H.-S. Kim et al. 2012). Therefore, individuals' perceived susceptibility can play an important role in intention to consider health-related issues.

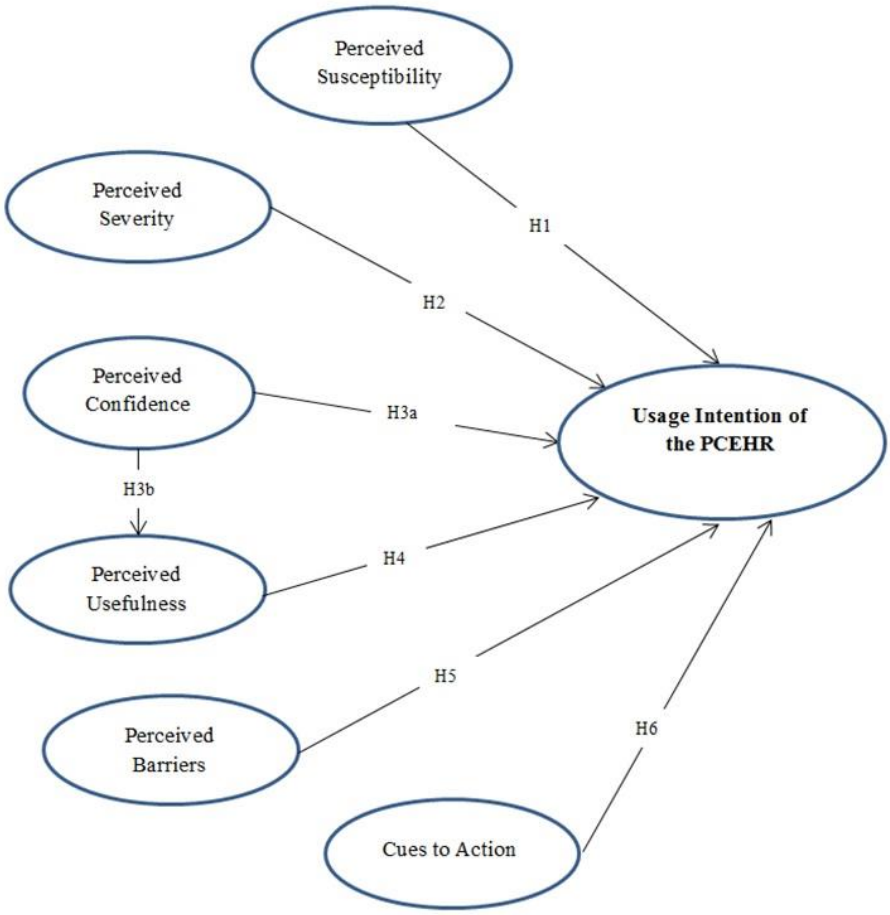


Figure 3.5 Research model

Adapting this to the domain of the PCEHR, if individuals feel that they are at risk of developing any diseases, they have more reason in their mind to make a behavior change and apply the system to improve their health conditions. Thus, the researcher puts forward the following hypothesis:

H1. Perceived susceptibility has a positive effect on the usage intention toward PCEHR.

Perceived severity (seriousness) is defined as the degree to which individuals think a specific disease or condition is serious (Janz and Becker 1984). According to the HBM, if individuals perceive a given health problem as serious, they are more likely to engage in activities/behaviors

to prevent the health problem from occurring or to reduce its severity (Rosenstock et al. 1994). Accordingly, the intention to use the PCEHR should depend on whether individuals perceive that their health conditions are serious. Thus, the researcher posits the following hypothesis:

H2. Perceived severity has a positive effect on the usage intention toward PCEHR.

Perceived confidence (self-efficacy) is defined as an individual's perception of their ability to successfully complete a specific task (behavior change) (Janz and Becker 1984). There is extensive evidence demonstrating the effect of perceived confidence on usage intention (Ahuja and Thatcher 2005; Bowles et al. 2015; Hall et al. 2015; Luarn and Lin 2005). The current literature offers studies that apply self-efficacy measures to predict technology use behaviors, the ability to make informed medical decisions (Chu and Mastel-Smith 2010), and individuals' confidence in their ability to obtain health information pertaining to treatment options and their concerns related to making informed choices (Bunn and O'Connor 1995; Campbell 2004). The researcher included this relationship in this study to test whether there is any influence of perceived confidence on the usage intention toward the PCEHR. There also exists empirical evidence of a relationship between perceived confidence and perceived usefulness. According to the literature, if individuals perceive a higher self-efficacy, they perceive the system to be easy and useful because of the effect of self-efficacy on the degree of effort, the persistence and the level of learning that takes place and will therefore be less resistant to change (Bandura 1977; Igbaria and Iivari 1995). Adapted to the domain of the PCEHR, individuals' perceived confidence is a motivational trigger to engage them in using the system. This information leads to the proposal of the following hypotheses:

H3a. Perceived confidence has a positive effect on the usage intention toward PCEHR.

H3b. Perceived confidence has a positive effect on the perceived usefulness of the PCEHR.

Perceived usefulness is considered as an individual's evaluation of the value or efficacy of engaging in health-promoting behavior to reduce the risk of a health condition (Davis 1989). Individuals may perceive that taking such action can result in a variety of benefits that go beyond improved health, including a variety of social, personal or financial benefits. There are various studies that have evaluated individuals' perceived usefulness of Health Information Technology (HIT) applications and claimed that a higher level of usefulness of the particular system will be positively associated with more intention to use the system (Myers et al. 2012; T. Wang and Biedermann 2010; Winkelman et al. 2005). In the case of the PCEHR, the intention to use the system should depend on individuals perceiving that the system has various advantages in improving health. Hence, the researcher hypothesizes that:

H4. Perceived usefulness has a positive effect on the usage intention toward PCEHR.

The next construct is perceived barriers. According to the HBM, perceived barriers refer to an individual's evaluation of the obstacles to behavior change. Barriers comprise activities that are difficult, inconvenient, disruptive to normal activities, or costly (Albert Boonstra and Broekhuis 2010b). According to the literature, the major perceived barriers related to computer-based systems are complexity of the system, hardware/software problems, lack of computer literacy, and time for documentation (Albert Boonstra et al. 2014; Granlien and Hertzum 2012; Wald et al. 2009). Similarly, various barriers should be addressed in the context of the PCEHR to evaluate the effect of individuals' perceived barriers on the usage intention toward PCEHR. Thus, the researcher puts forward the following hypothesis:

H5. Perceived barriers have a negative effect on the usage intention toward PCEHR.

Cues to action, as the last construct of the HBM, are the stimuli necessary to trigger the decision-making process to accept a recommended health action (Janz and Becker 1984). Cues to action comprise two different types. They can be internal, such as when an individual experiences a health problem, or external, e.g. communication through the media or with others who have the ability to influence the individual, such as friends and family members (Janz and Becker 1984; Rosenstock 1974). Individuals with similar health beliefs may adopt different health behaviors, based on whether or not they receive motivational cues. According to the HBM, cues to action can play an important role in individuals accepting particular health-related behavior. For example, Larson et al. (Larson et al. 1979) stated that patients who received postcard reminders tailored to the HBM were significantly more likely than members of comparison groups to obtain the flu vaccine. The researcher included the relationship between cues to action and intention to use in the context of the PCEHR to evaluate whether internal/external triggers impact on the usage intention toward the system. Therefore, the researcher proposes the following hypothesis:

H6. Cues to action have a positive effect on the usage intention toward PCEHR.

To evaluate these hypotheses, the researcher designed a survey that consists of 21 questions. Table 3.3 shows the references of each question in the survey.

3.4.4 Data Analysis

The Partial Least Squares (PLS) method implemented in SmartPLS was selected to perform a simultaneous evaluation of both the quality of measurement (the measurement model) and hypothesized relationships between the constructs (the structural model). The PLS approach is suitable for this study because it allows latent variables to be modeled with formative indicators in the structural model.

Table 3.3 Items development for the HBM constructs

Construct	Items	References
Perceived Susceptibility (Perceived Risks)	SQ1. I am aware of my health problems.	(Witte 1996)
	SQ2. I am at risk of getting health threat.	(Witte 1996)
	SQ3. I worry a lot about getting new health problem.	(Witte 1996)
Perceived Severity (Perceived seriousness)	SQ4. The thought of any health problems scares me.	(Witte 1996)
	SQ5. When I think health problems my heart beats faster.	(Witte 1996)
	SQ6. If I have any health problem my career will be endangered.	(Witte 1996)
Perceived Confidence	SQ7. I am confident that I can have a positive effect on my health.	(S. Y. Lee et al. 2008)
	SQ8. I have set some definite goals to improve my health.	(S. Y. Lee et al. 2008)
	SQ9. I feel that I am in control of how and what I learn about my health.	(S. Y. Lee et al. 2008)
Perceived Usefulness	SQ10. I think that using PCEHR will help me to manage my own health better.	(Venkatesh et al. 2002)
	SQ11. I think that using PCEHR will help me to improve my health care generally.	(Venkatesh et al. 2002)
	SQ12. I think that PCEHR will help me to get in touch with my doctors and other caregivers.	(Venkatesh et al. 2002)
Perceived Barriers	SQ13. I do not want a written record of sensitive personal health information in PCEHR.	(Venkatesh et al. 2002)
	SQ14. I do not trust the security of the currently available Internet-based systems.	(Venkatesh et al. 2002)
	SQ15. I have a concern about PCEHR functionality. I have a concern about how easy to delete, correct, or add information?	(Venkatesh et al. 2002)
Cues to Action	SQ16. When I take medicine, I try to get as much information as possible about its benefits and side effects.	(Frankenfield 2009)
	SQ17. Before making a decision about my health, I find out information from close others, the media, or health care providers.	(Dutta-Bergman 2004)

Table 3.3 Items development for the HBM constructs (continued)

	SQ18. Medical television shows make me think about getting a medical check-up.	(Dutta-Bergman 2004)
Usage Intention to the PCEHR	SQ19. I intent to monitor and manage the symptoms and signs of my health condition (s).	(Ajzen 2002)
	SQ20. I will try to manage the impact of my health condition(s) on physical functioning, emotions and interpersonal relationships.	(Ajzen 2002)
	SQ21. I plan to learn skills and techniques to manage the symptoms and overcome my health problems.	(Ajzen 2002)

Moreover, PLS is adequate because it is distribution-free (employing nonparametric bootstrap statistics), and it is thus insensitive to impurities in the model and the data. In addition, PLS path modeling has been widely applied in empirical studies of technology acceptance (Ahadzadeh et al. 2015; Alaiad and Zhou 2014; Kijsanayotin et al. 2009; Zhou 2012).

3.4.5 Ethical Clearance

All participants signed an informed consent form that was based on ethical approval as obtained from the Griffith University Research Ethics Committee for this study. The researcher provided an informed consent form, which covers the objectives, scope and nature of the project, and the expected benefit or potential harm that may come from participation (Appendix B). We provided a booklet that contained all the content in the program (an overview of activities in each week). He taught participants how to register and log in to the system. Each week, they read the week's content from the booklet, logged in to the PCEHR and completed that particular activity. Participants understood the nature of the research and knew that their participation was voluntary and that they could withdraw from the study at any time without penalty. They understood that

there were no direct benefits in this research. The participants were asked a series of questions about the PCEHR system and they were not required to answer every single question. The participants could pass on any question that made them feel uncomfortable. Participants were informed that the survey data would be used as a part of a PhD study and presented in the future, but that it would not include any identifying information about the participants. This part of the research has been approved by the Griffith University Human Research Ethics Committee with the reference number ICT/01/15/HREC.

3.5 Summary

This research consists of two studies to enable the determination of facilitators and barriers to EMR and PHR systems from the perspectives of both staff and customer users. Table 3.4 shows summary of research methodology for EMR and PHR studies.

The chapter continues by explaining the research approach that was employed for the EMR section of the study. The explained population and sample for the EMR study, data collection approach, data analysis (thematic analysis and grounded theory approach), validity and reliability and finally ethical clearance to conduct the EMR study. After that, he clarified the research methodology that was applied to evaluate factors impacting on the user adoption of the PHR. The author clarified population and sample for PHR study, data collection approach, research model and hypothesis development to identify the impact of the HBM factors on user adoption of PHR, data analysis, and finally ethical clearance to conduct the PHR study.

Table 3.4 Summary of research methodology

	EMR	PHR
Research Approach	Qualitative study	Quantitative study
Reason to select the research approach	The aim of this study was to gain an in-depth understanding of the barriers and facilitators to the adoption of EMRs by their users and the author applied an exploratory case study approach in order to generate an in-depth understanding of EMR adoption in a real-life context.	The main aim of this study was to design and develop mathematical models, theories and hypotheses.
Population	Healthcare professionals from Gold Coast University Hospital (GCUH) and Royal Brisbane & Women's Hospital (RBWH)	Individuals from members of the University of the Third Age (U3A)
Types of sampling	Snowball sampling	Purposive sampling
Method of data collection	Interviews and observation	Survey
Data analysis	Thematic analysis and grounded theory	The Partial Least Squares (PLS) method implemented in SmartPLS

CHAPTER 4

ANALYSIS AND RESULTS

4.1 Overview

This chapter is divided into two main sections: the EMR and PHR study. In the EMR study (Section 4.2), 78 interviews were conducted between August 2013 and September 2014. The results will be analyzed based on two qualitative approaches: thematic analysis and grounded theory. The author categorizes the results into ten main themes based on thematic analysis: (1) perceived benefits of EMR; (2) perceived difficulties; (3) hardware/software compatibility; (4) job performance uncertainty; (5) ease of operation; (6) perceived risk; (7) assistance society; (8) users' confidence; (9) organizational support; and (10) technological support. He identifies some contexts that impact the user adoption of EMR and require further investigation due to a lack of research in EMR literature. Furthermore, he analyzes the data based on three phases of grounded theory approach in Section 4.2.3. he identifies 24 open codes at the first stage. At the axial coding phase, he categorizes all these codes, based on their concept, into six themes. At the final phase (selective coding), he selects a focal core theme and clarified the relationship of it with other themes.

In the PHR study (Section 4.3), he presents the data, which was collected from hands-on PCEHR workshops. Finally, he clarifies the result based on the Health Belief Model (HBM).

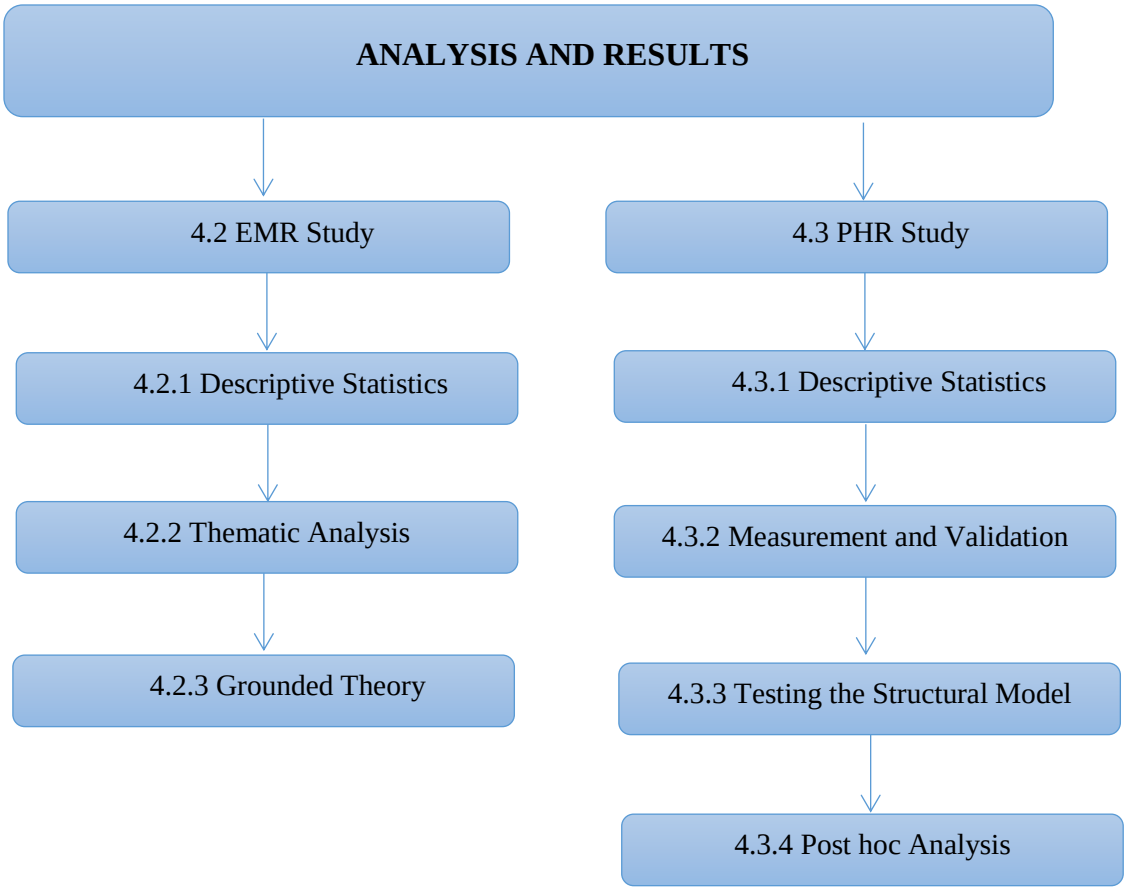


Figure 4.1 The outline of chapter four.

4.2 EMR Study

In this part of this thesis, the author aim to identify the determinants of the usage intention toward the EMR system. The researcher clarifies the results based on thematic analysis (Section 4.2.2) and grounded theory (Section 4.2.3) approaches to identify facilitators and barriers to the users' adoption of EMRs.

4.2.1 Descriptive Statistics

In total, 78 interviews were conducted with participants from two large hospitals in Australia. As a first question the researcher asked participants "How long have you been using EMRs?" A total of 69% of interviewees reported that they had more than two years of experience with EMR; 19% and 10% of participants had less than a year or 1–2 years' experience, respectively (see Table 4.1).

Table 4.1 How long the participants have used the system

Years of Experience	Percentage of Participants
More than 2 years	69%
1-2 years	10%
Less than a year	19%
Not Applicable	2%

The second question that the researcher asked the participants was "How often do you access EMRs?" According to Table 4.2, 63 of the interviewees used the system every day. Seven participants had weekly access and only one interviewee reported that they had monthly access to the EMR system. Finally, three participants answered that they have rarely accessed the EMR system because their area of work was unrelated to IT systems in the hospitals.

Table 4.2 How often the participants have used the system

Access Period	Number of Participants
Daily	63
Weekly	7
Monthly	1
Rarely	3
Not Applicable	4

Finally, the researcher asked interviewees about their roles in the hospital. He conducted 78 interviews with 15 different kinds of hospital staff (see Figure 4.2). Fifteen interviewees were dietitians and there were eleven allied health professionals. An allied health professional is a trained professional who works with others in the healthcare team to support a person's healthcare. The aim is to support diagnosis, recovery and quality of life. They are a distinct group of health professionals who use their knowledge and experience to prevent disease transmission, diagnose, treat and rehabilitate people of all ages and all specialties. Together with a range of technical and support staff they may deliver direct patient care, rehabilitation, treatment, diagnostics and health improvement interventions to maintain optimal physical, sensory, psychological, cognitive and social functions. Eight interviewees were occupational therapists and seven participants were social workers who used the EMR system. The remaining participants were a vascular specialist, a clinical education coordinator, and a chiropodist.

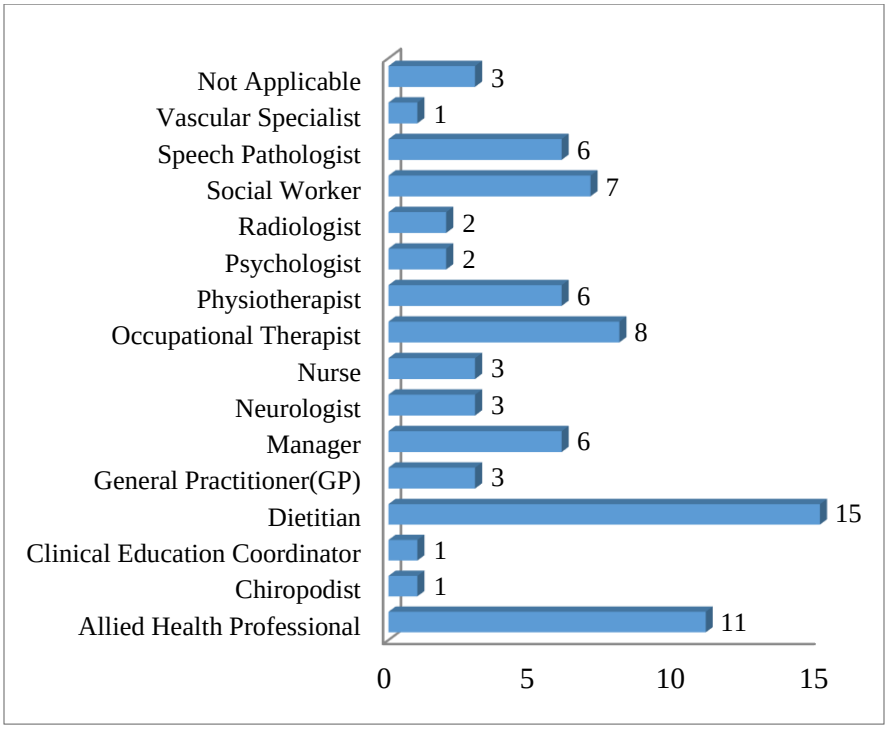


Figure 4.2 Different roles of the participants in the hospitals

4.2.2 Thematic Analysis

The adoption factors identified as a result of the data analysis stage helped the researchers to answer the research question set out earlier in this study. This section was divided into 10 major themes to clarify factors affecting EMR adoption, based on a thematic analysis approach (see Figure 4.3).

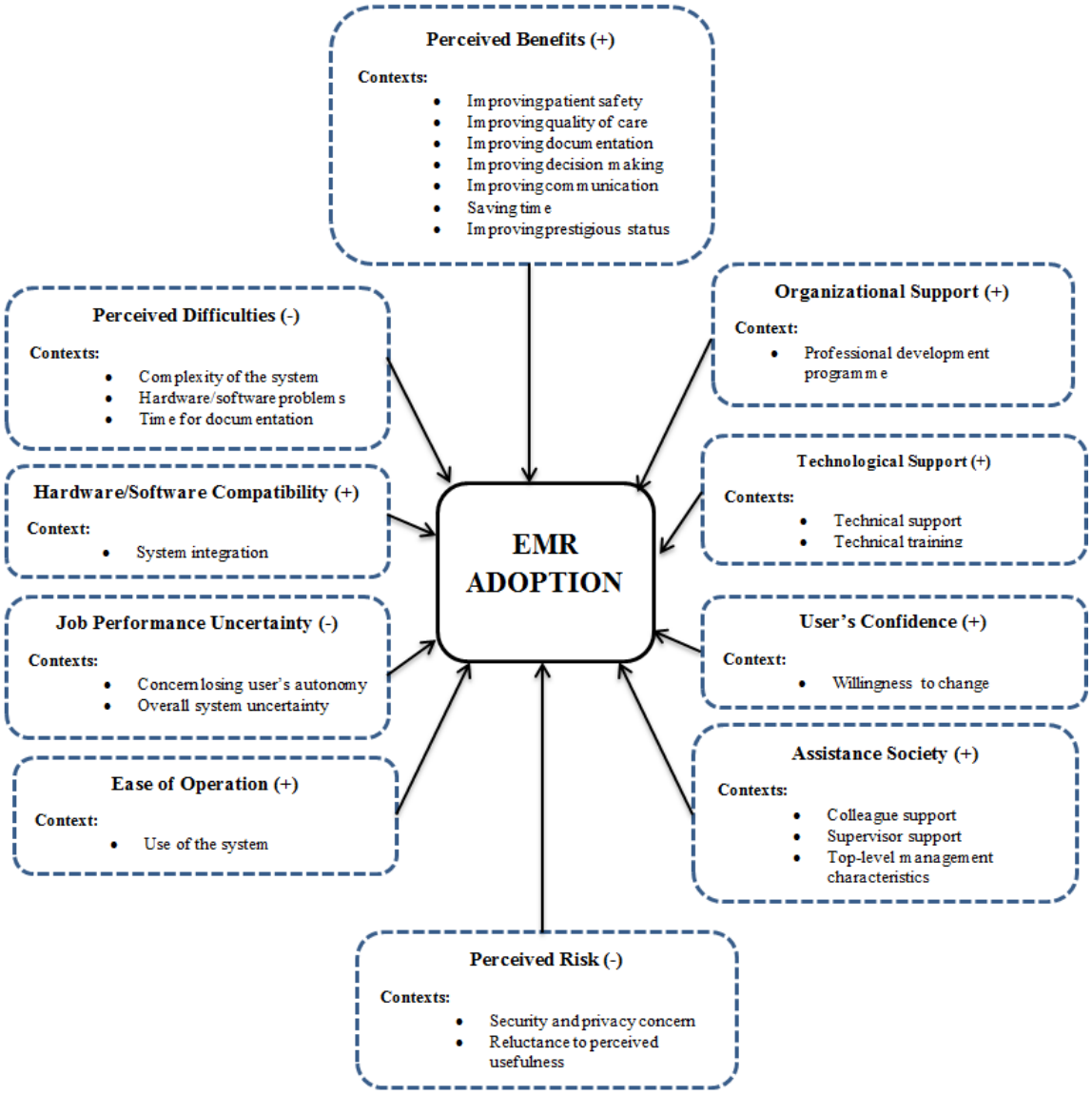


Figure 4.3 A schematic representation of factors impacting EMR adoption

4.2.2.1 Perceived Benefits

The first subjective factor is perceived benefits, defined as the degree of benefit gained from applying EMRs, including improving patient safety, improving quality of care, improving documentation, improving decision-making, improving communication, saving time, and improving prestigious status. Table 4.3 shows a summary of the different contexts related to the benefits of EMRs.

According to the transcripts, EMRs can provide higher quality and safer care for individuals and help healthcare providers to manage their patient records. For example, participant R38 reported 'I have a quicker response than other physicians, staff and patients due to applying EMRs in my workplace. I can read a patient's medical history more quickly than with a paper system.' Participant R18 noted 'It gives me the ability to read notes and orders when documented by others, access past history in readable format, and allows more than one clinician to access a chart at a time.'

Participant 29 said 'EMRs provide comprehensive and easy access to medical information so that we can make better decisions and use better judgment in the tasks, and we can focus on patient needs in the hospital'.

4.2.2.2 Perceived Difficulties

There are three main contexts related to perceived difficulties, including complexity of the system, hardware/software problems, and time for documentation. Some participants suggested that EMRs are a complex system in their workplace and that it takes time to master all functions.

Table 4.3 Summary of healthcare provider perceptions of EMR use (perceived benefits)

Description	The degree of benefits gained from applying EMR, including improving patient safety, improving quality of care, improving documentation, improving decision making, improving communication, saving time, and improving prestigious status.
Contexts	Improving patient safety Improving quality of care Improving documentation Improving decision making Improving communication Saving time Improving prestigious status
Example of data extracts	R18_improving patient safety: 'EMR has key functions that can improve patient safety because data is entered electronically. It means that written errors and typos are eliminated in this computer-based system.' R26_improving quality of care: 'patients' records in the EMR are more comprehensive than paper records and specialists can access these records and collaborate together to have better care.' Z21_improving documentation: 'By using EMR, I do not have to write on a piece of paper and I can type into well-formatted electronic forms. It can save our time to input patient data and decrease illegible hand writing.' Z17_improving decision making: 'EMR provides a clear record of a patient's journey in the hospital so we can make better decisions during patients' treatment.' R25_improving communication: 'We have an integrated system in the hospital. If patients go to see another doctor in a different department, they can send a message to the previous doctor and share the patient's data.' R28_saving time: 'I am able to look up notes quickly (compared with waiting for paper notes). I can look up notes from the office (with a cuppa), before getting to the ward (therefore I know if I need to print off resources).' R42_improving prestigious status: 'As a manager in the IT department, EMR can improve my image compared to the other hospital. I feel that I am more helpful to the patients when I use EMR.'

For example, Participant R30 reported, ‘It is difficult to read after multiple admissions time. To ponder over what you are writing can make it more time-consuming.’ Participant R31 believed, ‘It is difficult to know the correct file path under which to save an entry, there are so many options.’ Participant Z8 stated, ‘The system is not completely user-friendly. It is difficult to know the whole process of the system, and this impacts negatively on our productivity.’ Some participants reported different software and hardware problems while using EMRs. For instance, Participant R19 reported, ‘Occasionally computers are down, or I don’t have computer access for some reason.’ Participant R2 noted, ‘Occasionally the whole program will shut down and lose anything you were doing at the time.’ Participant R32 reported, ‘There are difficulties when our laptops run out of battery because GCUH doesn't have power points located where we need them in order to have laptops plugged in all the time. Difficulties with laptops “going to sleep” and clinicians losing notes – this requires a job to be logged with IT for each individual user on each laptop (very time-consuming when we have rotational staff). It's also an issue when the “Force Logoff”’ screen comes up.’ Participant R34 reported, ‘If the IT system goes down and notes cannot be accessed or written, I have to rewrite them and this is a waste of my time.’ Finally the last context in perceived difficulties is time for documentation (see Table 4.4). Some participants reported that they had to spend extra time importing data into EMRs. For example, Participant R26 noted, ‘I have to gather more detailed information to enter the EMR system (prescription section), so it takes time to complete all the digital forms.’ Participant Z8 noted, ‘I think that entering information on the computer is a waste of time. We have to enter all data and then scan all related medical images to the EMR system. We have to fill out all relevant information.’

Table 4.4 Summary of healthcare provider perceptions towards EMR use (perceived difficulties)

Description	The degree of different problems that users faced when applying EMR in their workplace.
Contexts	Complexity of the system Hardware/software problems Time for documentation
Example of data extracts	R5_complexity of the system: 'We lose documentation sometimes if it has not been saved. It's not easy to cut and paste from each program. You need to paste into a word document from meta-vision (specific program in the hospital) and then into EMR.' R4_ hardware/software problems: 'The system occasionally fails (meaning no access to notes). People don't put their clinical notes on promptly, so these notes cannot be accessed. I have to spend more time at the computer.' Z14_time for documentation: 'Data entry takes a long time because we have to convert all charts and images, and I think that this should be improved to save nurses' time.'

4.2.2.3 Hardware/Software Compatibility

Hardware/software compatibility is the third subjective factor with a positive effect on the user adoption of EMRs (see Table 4.5). Different computer systems should work together physically and functionally as a single system to increase work productivity in the healthcare organization. Some participants noted their experience that having an integrated computer system motivates users to use EMRs to save time and decrease effort. For example, Participant R19 reported 'By using the EMR system in my work I can manage my documents and decrease duplication. I can send a patient's data to the surgeon in a few minutes and it can save my time and effort.' Participant

R35 noted ‘This system helps me to send a waiting list to the practice management system to create a report.’

Table 4.5 Summary of healthcare provider perceptions of EMR use (hardware/software compatibility)

Description	This factor identifies the extent to which the EMR system is perceived to fit with the adopter’s current values, healthcare policies, prior experience, relevant competences, or existing IT needs.
Contexts	System integration
Example of data extracts	R44_system integration: ‘The benefit of the EMR system is connection with decision support systems so that managers can monitor workflow in the whole hospital. We don’t need anyone to enter data into the decision support system so it cuts down time taken on documentation.’

4.2.2.4 Job Performance Uncertainty

Job performance uncertainty is the fourth subjective factor. It was defined as the degree to which a user believes that applying the system will waste their time and lose job performance (see Table 4.6). This subjective factor was observed in two major contexts, including concern about losing user autonomy and overall system uncertainty. For example, some participants believed that healthcare providers lose their control over medical information and the patient treatment process by using the EMR system. Participant R49 noted, ‘I like to have control over my patients’ documentation. Sometimes EMR makes managing my files complex. I like to know the whole process of reporting and charting within the system.’ Participant Z18 reported ‘Other doctors can access my patients’ information and monitor my processes.’ Some participants reported that they have faced various problems when using EMRs and they cannot trust this system. Participant R19 reported, ‘The system occasionally fails and I do not have access to notes. This is really important

in an emergency situation.' Participant Z15 reported, 'Sometimes scanned information is scanned into the wrong patient chart, or under an incorrect heading, and it makes it difficult or impossible to find relevant data. I cannot trust the EMR system at all.'

Table 4.6 Summary of healthcare provider perceptions of EMR use (job performance uncertainty)

Description	The degree to which a user believes that applying the system will waste his or her time and lose job performance.
Contexts	Concern about losing user's autonomy Overall system uncertainty
Example of data extracts	R15_ concern about losing user's autonomy: 'I think that by using EMR we lose control over medical information, because data is shared with others and they can evaluate and modify that information.' R37_ overall system uncertainty: 'On a few occasions my data has been deleted by EMR. If it cannot be retrieved, this puts me under risk of litigation if evidence of my encounter with a patient is not input into patient charts.'

4.2.2.5 Ease of Operation

The next subjective factor, ease of operation, was identified as the degree of ease associated with the use of EMRs (see Table 4.7). Some participants believed that the EMR system is easy to use and reported that they liked to apply this system in their tasks in the hospital. Participant R27 reported, 'I found it easier to flick through a paper chart and you could easily see their journey through outpatients and the number of admissions; I could quickly gauge what they were for and their duration.' Participant Z19 reported 'EMRs make my work easier and I can manage my data for each patient consistently. It is a user-friendly system where with simple clicks I can monitor my patients' status.' Participant Z13 noted, 'Compared to paper-based health records, accessing

and managing medical data has become easier. It is easy to find suitable information and track a patient's journey in the hospital.'

Table 4.7 Summary of healthcare provider perceptions of EMR use (ease of operation)

Description	The degree of ease associated with the use of EMR.
Contexts	Use of the system
Example of data extracts	R25_ use of the system: 'I can easily sort notes by date or type or profession. It can save my time and documentation, so that I can focus on my career.'

4.2.2.6 Perceived Risk

The sixth subjective factor, perceived risk, reflects the individual's perception of the uncertainty of system outcomes and information security (see Table 4.8). This subjective factor appeared in two main contexts: security and privacy concerns, and reluctance to perceive usefulness (psychological risk). For example, some participants noted that EMRs are not a secure place to store patient health-related information. Participant Z19 reported, 'I am worried about computer problems and viruses attacking the system. They cause loss of access to medical records in the hospital.' Participant R47 noted, 'I understand EMRs can improve quality patient care, but let's talk about security breaches in the system. I have a problem with my desktop computer at home and it can also happen in my office.' In the second main context, reluctance to perceive usefulness (psychological risk), users were stressed and anxious about applying EMRs in their workplace. The majority of participants believed that EMRs can improve patients' care in the hospital, but on the other hand, some participants reported that they were skeptical about EMR benefits and were unwilling to adopt this system in their work. Participant Z13 reported 'When using the EMR system I had to change my working style and it decreases my interaction with

patients. I believe that it is not necessary to use EMRs because all technologies bring particular problems.'

Table 4.8 Summary of healthcare provider perceptions of EMR use (perceived risk)

Description	The degree of technical infrastructure to help individuals to use EMR system.
Contexts	Security and privacy concern Reluctance to perceive usefulness
Example of data extracts	R18_ security and privacy concerns: 'Paper-based medical records are much more secure than computer-based systems. Hackers can attack the system and destroy everything.' R48_ psychological risk: 'As a department supervisor, I know nurses who are reluctant to see the benefits of the system, so they are likely to do more paper work in the department. The nurses think that they have to spend more time in data entry processes.'

4.2.2.7 Assistance Society

Assistance society is the next factor, identified as various social supports that can help individuals to use the EMR system (see Table 4.9). This factor was identified in three main contexts, including colleague support, supervisor support, and top-level management characteristics. As a first context, some participants reported that when they face a problem with EMRs, before calling the IT department they ask their colleagues if they can solve that specific problem. Participant R15 noted, 'I have a problem with using EMRs in my tasks. Sometimes I cannot see my patient's medical records and I ask my colleague, who has more experience with EMRs, to help me.' Participant R41 said, 'I think that one of the most important reasons I am able to use EMRs was my old friend in the hospital. He has been happy to help me to understand the

EMR functions.' The second context in the assistance society factor was supervisor support. Some participants reported that managers and supervisors in each department play a significant role in the success of EMRs. Participant R45 believed that department managers and supervisors can promote the EMR system in the department: 'In our department, we have a supervisor who has already been trained by the EMR support team, and he is really supportive when staff face EMR issues.'

Table 4.9 Summary of healthcare provider perceptions of EMR use (assistance society)

Description	The degree of society support that can help individuals to use the EMR system.
Contexts	Colleague support Supervisor support Top-level management characteristics
Example of data extracts	Z11_colleague support: 'I do not have such good computer skills as my supervisor and colleagues. They are really helpful in solving my problems.' R12_supervisor support: 'I think that the supervisor of each department should not only focus on managing line tasks, but should support their staff in other ways such as with technology-based issues. They should have regular contact with the EMR team to keep up to date with the latest EMR functionalities and changes.' R28_top-level management characteristics: 'I have attended different computer training sessions such as TAFE to know about various functions of computers (software). I would like to make a connection with health care companies to bring new technology such as Cloud-based systems.'

Participant R50 reported, 'My supervisor motivates me to attend EMR training sessions and gives me the opportunity to understand the whole system.' Finally, some participants reported that

top-level management characteristics such as computer knowledge and manager innovativeness can help with EMR adoption. For instance, Participant Z12 reported, 'I think that the management team should have original ideas and promote EMRs by providing practical policies.' Participant R44 noted, 'As a manager I would sooner provide new standards to eager users in the hospital to accept new technologies in the hospital. I think incentives should work in this case.' Participant R17 reported, 'I believe that computer technology improves the performance of my employees.'

4.2.2.8 User Confidence

The next subjective factor that impacts user adoption of EMRs is user confidence (see Table 4.10). This was defined as the strength of an individual's belief in their own ability to complete a specific task. It appeared in the context of the readiness of users to accept change in their tasks. For instance, Participant R37 reported 'I really like to try new things in my life. When I knew about the computer I was eager to learn new techniques.' Participant R12 noted 'We must accept new technologies like EMRs to make tasks easier. I understand that new computer technology can assist us to complete boring office work.' Participant R14 reported 'I started my work in GCUH two years ago. I knew about the benefits of the EMR system because I used this kind of system in my previous hospital. It provides comprehensive patient records for healthcare providers. I was aware that I can check documents from different departments based on a written date. So at that time I was eager to learn the new features of EMRs in GCUH.'

Table 4.10 Summary of healthcare provider perceptions of EMR use (user confidence)

Description	The degree of individual's belief in own ability to complete specific task.
Contexts	Willingness to change
Example of data extracts	R43_willingness to change: 'I believe that the EMR system can improve quality of care by organising medical information. By using the EMR system, doctors can interact with their patients in a timely manner. I am completely happy to use the computer system instead of paper documents.'

4.2.2.9 Organizational Support

The ninth factor is related to organizational issues (see Table 4.11). Two participants (top-level managers) identified the professional development programme as a useful organizational programme to help EMR user to adopt the system in their workplace. They reported that professional development programs in hospitals can support healthcare professionals in using clinical and computer-based systems. Participant R17 noted, 'We have organized various clinical development programs such as clinical governance study, medical nursing study, surgical nursing study, computer-based technology study, and central venous access devices workshops in the next year. These kinds of programs utilize a work-integrated learning approach to help the acquisition of competences and knowledge about clinical and technical issues. Staff can attend these workshops and programs to develop their skills in the hospital. We had a similar program in the Robina Hospital and we had good feedback from participants.'

Table 4.11 Summary of healthcare provider perceptions of EMR use (organizational support)

Description	The degree of individual's belief in own ability to complete specific task.
Contexts	Professional development programme
Example of data extracts	R28_ professional development programme: 'performance development modules in the hospital can be useful to develop users' skills with the technology. Training is the first phase of performance development and we should encourage different department to set training sessions.'

4.2.2.10 Technological Support

The last subjective factor is technological support, defined as the technical infrastructure to help individuals to use the EMR system, including technical support and technical training (see Table 4.12). These two technical features were observed in different contexts. For instance, some participants reported that internal technical support in the hospital is available for solving EMR system problems. Participant R24 noted 'I think that using the EMR system is not possible without technical support from the IT department. I'm happy that they gave us immediate feedback to solve our problem.' Participant 45 reported that 'Lack of IT support discourages users from using the EMR system because we have a fear of system failure during EMR use.' Internal technical support in organizations can be over the telephone, email-based system, or a live support system. If there is not continuous support for EMR users, they become disappointed, resulting in their unwillingness to adopt EMRs in their daily tasks. Some participants reported that technical training is an effective way to motivate users to use the EMR system. Participant R34 indicated: 'I feel confident about using EMR after attending training sessions. They are good opportunities for staff to ask EMR experts about system difficulties.' Participant R9 reported 'In the annual managers meeting, I suggested running online training sessions for doctors to highlight potential problems

and propose solutions. It should be a useful approach for doctors that are busy with their work in the hospital. They can manage their time to attend online sessions.'

Table 4.12 Summary of healthcare provider perceptions of EMR use (technological support)

Description	The degree of technical infrastructure to help individuals to use EMR system.
Contexts	Technical support Technical training
Example of data extracts	R10_technical support: 'When I faced any problems related to the EMR system, IT staff members were available by phone to help me to solve that issue. They are on the phone until I am OK with the system.' R35_technical training: 'Before conducting EMR training, user computer skill should be evaluated in order to have effective training. Based on individual computer skills GCH hospital can run different levels of training workshops.' Participant R49 expressed 'Formal technical training can help nurses to boost their computer skills to use EMR and I think that it's essential for new staff.'

4.2.3 Grounded Theory

As mentioned in the methodology section, the initial stage of data analysis, based on grounded theory, is open coding. A total of 24 open codes were identified based on transcripts of 78 interviews, after merging and removing open codes based on their meanings. In this stage, the researcher read through the transcripts several times, and afterwards the researcher started to make tentative labels for each part of the data, based on its meaning. Phrases with similar ideas/meanings were merged with the same open code; otherwise, a new open code was proposed to make comprehensive lists of codes. In the second stage of data analysis based on grounded theory, the

researcher tried to make connections between codes and to create themes (axial coding). He identified six major themes in the axial coding phase (See Figure 4.4).

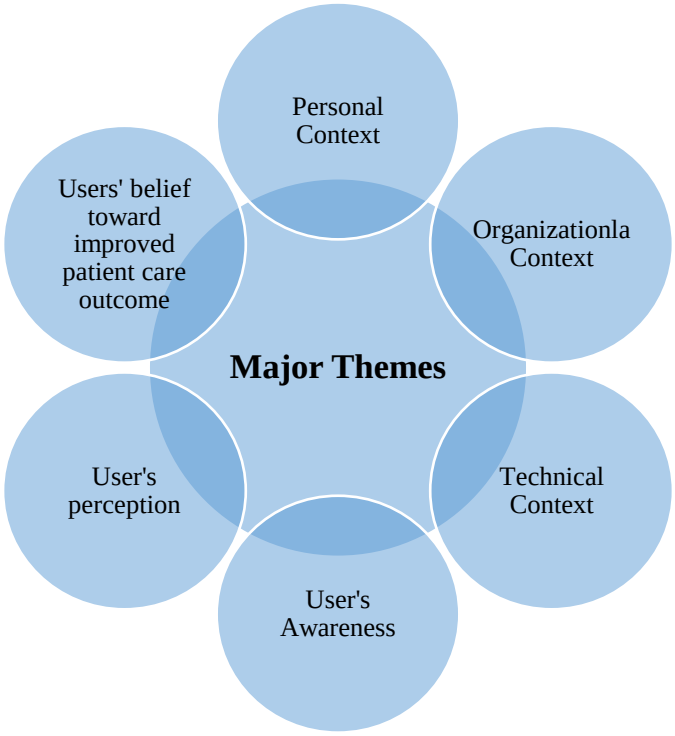


Figure 4.4 Six major themes extracted from transcripts of interviews based on axial coding phase

Furthermore, Table 4.13 shows 24 open codes and six main themes extracted in the axial coding phase. The author identified related references from prior research to support the results. In addition, he highlighted the percentage of participants that stated each specific code and provided an example of respondents for each of them. In the last phase of data analysis (selective coding), he attempted to refine the conceptual model of users' experience of EMRs. The researcher involved the process of selecting and identifying the core theme and systematically relating it to other themes. This phase involved validating those relationships, filling in, and refining and developing those themes.

Table 4.13 Open codes and categories extracted in axial coding phase

Open codes with evidence from prior research	Percentage of participants to offer this experience	Example of respondents	Themes
Basic computer knowledge (Albert Boonstra and Broekhuis 2010b; Kahouei et al. 2015; Terry et al. 2009)	23%	"It is essential to have basic computer skills and I think that the majority of users (especially aged below 40) learned at their college."	Personal context
Prior experience (A. Boonstra and Broekhuis 2010a; Chaplin et al. 2015; Harle et al. 2014; Roberts et al. 2014)	10%	"I worked with EMR when I was in Robina Hospital. I knew the potential benefits of EMR and also knew how to scan medical images and import them to the computer system. Therefore, I did not have specific problems in working with the new EMR system."	
Colleague support (M. Najaftorkaman et al. 2013a)	37%	"I have a problem with using EMR in my tasks. Sometimes I cannot see my patient's medical records and I ask my colleague, who has more experience with EMR, to help me."	Organizational context
Supervisor support (Albert Boonstra et al. 2014; Weir et al. 1994)	15%	"In our department, we have a supervisor who has already been trained by the EMR support team, and he is really supportive when staff face EMR issues."	
Professional development programs (Bronder et al. 2015; Johnson et al. 2011; Wolf et al. 2004)	13%	"Performance development modules in the hospital can be useful to develop user's skills with the technology. Rising awareness is the first phase of performance development and we should encourage different department to set professional development sessions."	
Training (Margalit et al. 2006; C. J. McDonald 1997)	27%	"I feel confident about using EMR after attending training sessions. They are good opportunities for staff to ask EMR experts about system difficulties. These kinds of workshops can helpful to know about the benefits and various functions of the system"	

Table 4.13 Open codes and categories extracted in axial coding phase (Continue)

Open codes with evidence from prior research	Percentage of participants to offer this experience	Example of respondents	Themes
Time for documentation (A. Boonstra and Broekhuis 2010a)	24%	"I have to gather more detailed information to enter the EMR system (prescription section), so it takes time to complete all the digital forms."	Technical context
Hardware/software problems (Krall 1995; M. Najaftorkaman et al. 2013a)	72%	"Occasionally computers are down, or I don't have computer access for some reason."	
System integration (Albert Boonstra and Broekhuis 2010b; M. Najaftorkaman et al. 2013a)	10%	"The benefit of the EMR system is connection with decision support systems so that managers can monitor workflow in the whole hospital. We don't need anyone to enter data into the decision support system so it cuts down time taken on documentation."	
Technical support (Pera et al. 2014; Samuel 2014; Vrieze et al. 2014)	46%	"When I faced any problems related to the EMR system, IT staff members were available by phone to help me to solve that issue. They are on the phone until I am OK with the system."	
User's awareness/understanding (Crosby et al. 2014; Pera et al. 2014)	53%	"I attended practical workshop last week in our IT department. It gave me some useful hints to work better with EMR. I think that if I have suitable knowledge in EMR, I can complete my tasks easier than paper-based system."	Users' awareness
Readiness to change (Albert Boonstra and Broekhuis 2010b)	19%	"I really like to try new things in my life. When I knew about the computer I was eager to learn new techniques."	Users' perception
Perceived user's autonomy (A. Boonstra and Broekhuis 2010a; M. Najaftorkaman et al. 2013a)	9%	"I like to have control over my patients' documentation. Sometimes EMR makes managing my files complex. I like to know the whole process of reporting and charting within the system."	
Perceived ease of use (Rao et al. 2011; Zhang et al. 2012)	46%	"I found it easier to flick through a paper chart and you could easily see their journey through outpatients and the number of admissions; I could quickly gauge what they were for and their duration."	
Perceived privacy issues (Norm Archer and Cocosila 2009; Becker and Sewell 2004; M. Najaftorkaman et al. 2013a)	24%	"I am worried about computer problems and viruses attacking the system. They cause loss of access to medical records in the hospital."	

Table 4.13 Open codes and categories extracted in axial coding phase (Continue)

Open codes with evidence from prior research	Percentage of participants to offer this experience	Example of respondents	Themes
Improving patient safety (Meeks et al. 2014; Mott and Bowman 2014; Verbakel et al. 2014)	35%	"EMR has key functions that can improve patient safety because data is entered electronically. It means that written errors and typos are eliminated in this computer-based system."	Users' belief toward improved patient care outcome
Improving quality of care (Rao et al. 2011; Zhang et al. 2012)	55%	"Patients' records in the EMR are more comprehensive than paper records and specialists can access these records and collaborate together to have better care."	
Improving documentation (T. Wang and Biedermann 2010)	27%	"By using EMR, I do not have to write on a piece of paper and I can type into well-formatted electronic forms. It can save our time to input patient data and decrease illegible hand writing."	
Improving decision making (Mutale et al. 2013; Pomares-Quimbaya et al. 2014)	24%	"EMR provides a clear record of a patient's journey in the hospital so we can make better decisions during patients' treatment."	
Improving communication (Yamamoto and Khan 2006)	33%	"We have an integrated system in the hospital. If patients go to see another doctor in a different department, they can send a message to the previous doctor and share the patient's data.'	
Saving time (T. Wang and Biedermann 2010)	18%	"I am able to look up notes quickly (compared with waiting for paper notes). I can look up notes from the office (with a cuppa), before getting to the ward (therefore I know if I need to print off resources)."	
Difficulty (Granlien and Hertzum 2012; Tang et al. 2006a)	13%	"Based on current EMR problem, I reckon that this system is not easy to apply in our sensitive tasks"	
Suspicion (Miller and Sim 2004)	10%	"By using the EMR system I had to change my working style and it decreases my interaction with patients. I believe that it not necessary to use EMR because all technologies bring particular problems."	
Legal concern (Albert Boonstra and Broekhuis 2010b)	8%	"I am worried about computer problems and viruses attacking the system. They cause loss of access to medical records in the hospital."	

The researcher selected users' beliefs toward improved outcomes as a focal core theme and explained the relationship of the core theme with others (see Figure 4.5). The researcher selected this theme as a central theme because (1) it was central, with many relationships to other categories; (2) it was easy to relate to other codes and themes; (3) it appeared frequently in the data, denoting its importance; (4) it moved ideas forward as links and more meaning is uncovered related to healthcare.

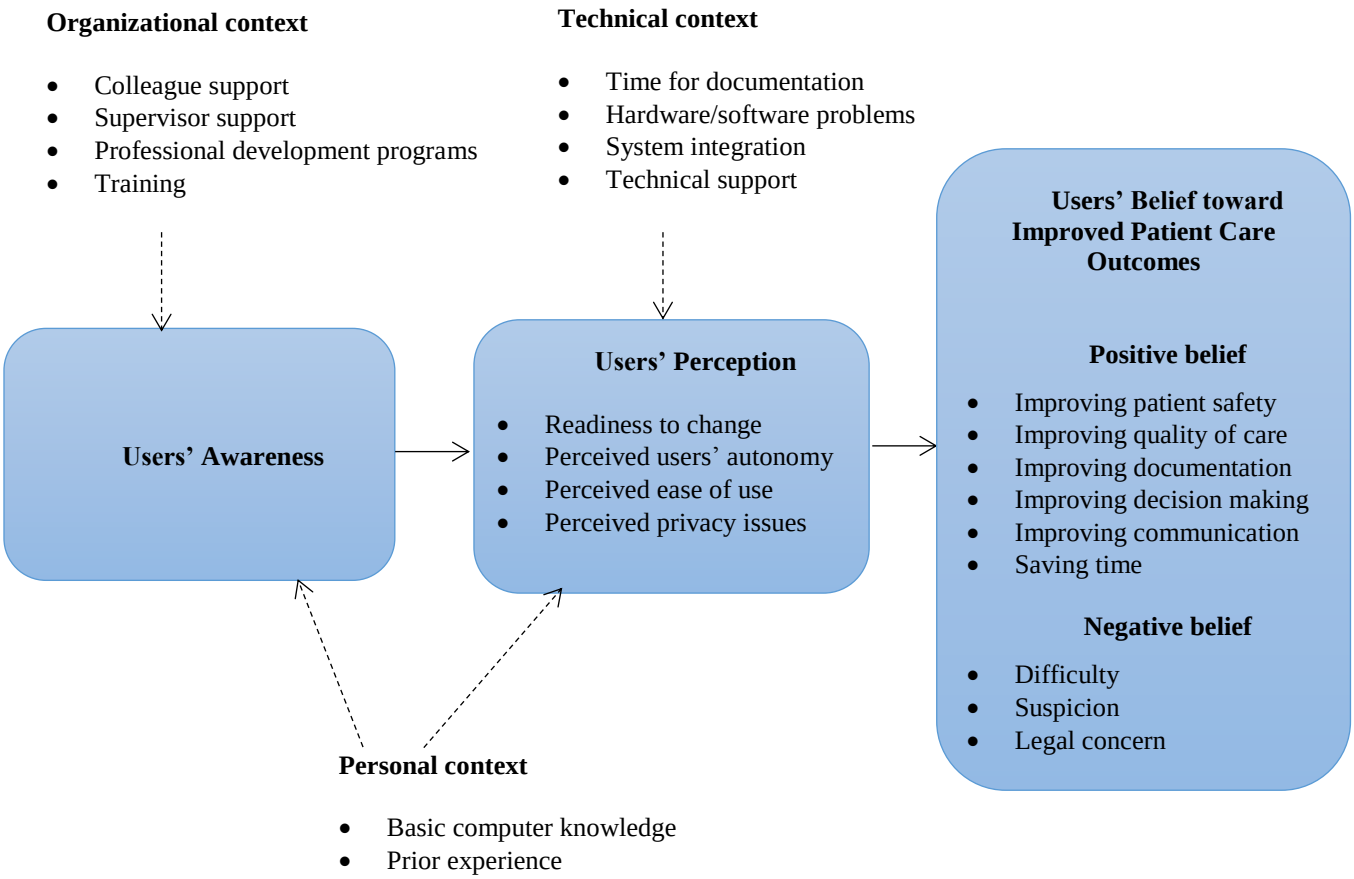


Figure 4.5 A framework of healthcare professional's experience toward using EMRs based on selective coding

4.2.3.1 Users' Awareness

Users' awareness is defined as the integration of new information with previous knowledge of a composite mental picture, and then to apply that coherent picture in directing future perceptions and expected future events (Salmon et al. 2008). According to the result, the users' awareness was based on the participants' real knowledge and facts related to the system. The researcher found that users' previous experience and computer literacy have a positive impact on their understanding/awareness. Healthcare professionals who have more knowledge about computers are more likely to attend training sessions to learn about new features of EMR.

'EMR users should have computer knowledge to navigate EMR and use different EMR functions. I used different multi-function programmes before using EMR in the hospital … I like to know about various modules of EMR by asking my superiors and attending educational workshops …'

'I started using EMR when I worked as a dietician with the Diabetes Resource Centre. I left the centre in late 2012 and started work in the new hospital … I attended introduction sessions in the previous hospital and I think that it was helpful to upgrade my knowledge, so I like to attend current training sessions that provided by new hospital.'

In addition, the researcher found that there were some organizational factors (colleague support, supervisor support, and senior management characteristics) that can impact users' awareness/understanding.

Furthermore, 37% of participants asked their colleagues when facing any problems during using EMR. They sated that having supportive colleagues could improve their knowledge of EMR systems.

‘I have a problem with using EMR in my tasks. Sometimes I cannot see my patient’s medical records and I ask my colleague, who has more experience with EMR, to help me. He is really helpful to teach me different functions of EMR’

Moreover, 15% of participants stated that their supervisor’s support was a really helpful factor in motivating users to learn more about the system. Senior supervisors who are more innovative, more likely to seek out new information, and are more knowledgeable toward technology are more likely to be motivators for staff acceptance of new technology.

‘… the supervisor of each department should not only focus on managing line tasks, but should support their staff in other ways such as with technology-based issues. They should have regular contact with the EMR team to keep up to date with the latest EMR functionalities and changes.’

In addition to factors impacting on Users’ awareness, some participants stated that professional development programs could help them boost their understanding of computer-based systems, such as EMR, in hospitals. Professional development opportunities can include various formal types of vocational education, group or individual learning workshops, single training sessions or semester-long workshops.

‘We have organised various clinical development programs such as clinical governance study,… , computer-based technology study, and central venous access devices workshop in the

next year. The main purpose of these programs is increasing staffs' understanding toward current systems in the hospital.'

Finally, 27% of participants believed that training sessions and workshops increase users' understanding of the benefits and drawbacks of EMRs in healthcare sectors. Training conducted in various formats, such as classroom training, online forums, e-learning, and different interactive online learning modules, can help healthcare professionals adopt EMRs in their workplaces.

'Before conducting EMR training (online or in-person), user computer skill should be evaluated in order to have effective training,... Based on individual computer skills GCH hospital can run different levels of training workshops. These workshops will be helpful to show potential solutions for common system failures. Moreover, the users can know more about the benefits of EMR functionalities.

4.2.3.2 Users' Perception

A user's perception is the sensory experience of the world around him or her and it has two sides: the recognition of environmental stimuli and actions in reaction to these stimuli (Shoham and Del Val 1991; Smith 2001). There are four main codes related to this context, including readiness to change, perceived user autonomy, perceived ease of use, and perceived privacy concerns. Some participants (5%) expressed that they are willing to change/open to applying new system/technology in their workplace to improve the quality of care.

'We must accept new technologies like EMR to make tasks easier. I understand that new computer technology can assist us to complete boring office work.'

On the other hand, 14% of participants were reluctant to change. They claimed that they have their own lifestyle and they perceived that it was difficult to switch to a new style/system.

'Everything seems difficult in the EMR system (from scanning documents to displaying them on the monitor) ... I am sure that EMR is beneficial to improve our tasks, but I am confused all the time about various functions and I would like to go back to paper medical records because I don't have complete knowledge about EMR.'

The second code in this theme is perceived user autonomy. Some participants (9%) were unsure about applying EMR systems in their workplace because they thought that other healthcare professionals could change their patient's data by connecting to the EMR system. They had a concern about their professional autonomy when applying the EMR system in hospitals.

'I like to have control over my patients' documentation. Sometimes EMR makes managing my files complex. I like to know the whole process of reporting and charting within the system.'

In addition, 46% of participants stated that using the EMR system was easy for daily tasks. If users perceive that the system is effortless and beneficial for managing data, they are more likely to adopt the system.

'I found it easier to flick through a paper chart and you could easily see their journey through outpatients and the number of admissions; I could quickly gauge what they were for and their duration. Totally, I realize that EMR is user-friendly system and can improve patient care.'

On the other hand, 18% of participants perceived that EMR was a complex system and they had to spend more time to complete their tasks. It is one of the major negative factors affecting users' readiness to change.

‘The system is not completely user-friendly. It is difficult to know the whole process in the system, and this impact negatively on our productivity.’

The last open code related to this theme is perceived privacy issues. In the study, 24% of participants had a concern about privacy and security issues. They perceived that applying computerized medical record systems in hospitals could have a negative impact on patient privacy.

‘I understand EMR can improve quality patient care, but let’s talk about security breaches in the system. I have a problem with my desktop computer at home and it can also happen in my office.’

4.2.3.3 Factors Impacting Users’ Perception

The data shows that EMR users that had better basic computer knowledge and prior experience with similar computer-based systems had better perceptions of using the EMR system. In all, 23% of participants stated that having basic computer knowledge and being proficient in mouse and keyboard skills are needed to effectively use the EMR system.

‘Computer competences are needed such as the ability to use software and hardware such as scanners, printers and webcams. I found easy to switch to EMR because I have already know about basic computer functions’

Furthermore, 10% of participants shared that they have had used EMR in the other healthcare sectors before using the current EMR system. They were open to accepting new EMR systems because they had already known about the benefits of EMR systems.

‘I worked with EMR when I was in Robina Hospital. I knew the potential benefits of EMR and also knew how to scan medical images and import them to the computer system. Therefore, I did not have specific problems in working with the new EMR system.’

Moreover, 24% of participants stated that they needed more time for data documentation. They believed that they could focus on patient issues instead of spending their time on documentation. They confessed that they do not have sufficient keyboard/mouse skills for entering medical data into the EMR.

‘The EMR interface is complex to use. There are so many buttons to view the history of patients in the system. There is no complete reporting system to show the whole journey.’

Additionally, 72% of participants expressed different hardware/software problems during using EMR such as lack of customization, system power lose, system freezing, lack of ergonomic considerations. It can be different from one to system to the next, but the main root is system infrastructure problems. Some of these participants stated that they faced these kinds of problem regularly, so the problems had a negative impact on their perception.

‘We lose documentation sometimes if it has not been saved. It's not easy to cut and paste from each program. You need to paste into a word document from meta-vision (specific program in the hospital) and then into EMR. Recently, I found a way that I can type my texts into word processing program and after that I can copy form this file.’

Another technical issue that impacted users’ perceptions is EMR integration with different systems in the hospitals. The participants stated that it was easy to connect the EMR system to the

other computer-based systems in order to manage daily tasks. They were willing to learn about more features of the system to save time.

‘By using the EMR system in my work I can manage my documents and decrease duplication. I can send a patient’s data to the surgeon in a few minutes and it can save my time and effort.’

The last technical issue that impacted users’ perceptions is technical support. For instance, 46% of participants reported that internal technical support in the hospital is available to solve EMR system problems.

‘I think that using the EMR system is not possible without technical support from the IT department. I’m happy that they gave us immediate feedback to solve our problem.’

Finally, users’ recognition and interpretation of sensory information (perception) related to EMR can be impacted by their understanding/awareness. The researcher found that if users increased their knowledge of EMR, they were more likely to perceive EMR as beneficial. On the other hand, individuals that did not have enough knowledge about the system believed that using EMR could negatively impact their autonomy and threaten patients’ data.

‘In the annual managers’ meeting, I suggested to run online training sessions for doctors to highlight potential problems and propose solutions … by increasing EMR knowledge among users, they are more likely to use EMR in their tasks’

‘After attending EMR workshops last month, I find EMR as a useful system to help me in my work. ’

4.2.3.4 Users' Belief toward Improved Patient Care Outcomes

The majority of interviewees believed that EMR has various benefits for improving patient care based on their experience with EMR. The researcher divided these positive benefits into six different clusters: improving patient safety, improving quality of care, improving documentation, improving decision making, improving communication, and saving time. For real experience, the majority of participants found EMR to be a useful system in the healthcare sector to improve patient safety and quality of care. It was believed that broad adoption of EMR can lead to major health care savings, reduce medical errors, and improve health.

'It gives me the ability to read notes and orders when documented by others, access past history in readable format, and allows more than one clinician to access a chart at a time.'

'Multiple people can access the same chart at the same time by using EMR. Records are easier to locate based on previous admissions. After using EMR more than 4 years, I believe that it is useful system to save time.'

'By using EMR, I can find categorized information in each department and assess the needs of them and finally, find the solution to overcome these needs.'

'I believe that we have more complete and accurate health-related information by using EMR rather than paper systems.'

On the other hand, there were some participants that believed that EMR is not a useful system and they wanted to change to a paper-based system. We divided the negative beliefs into three clusters: difficulty (13%), suspicion (10%), and legal concerns (8% of participants).

"As a department supervisor, I know nurses who are reluctant to see the benefits of the system, so they are likely to do more paper work in the department. The nurses think that they have to spend more time in data entry processes… believe that using EMR can prevent them to have more interaction with patients."

"The EMR interface is complex to use. There are so many buttons to view the history of patients in the system. There is no complete reporting system to show the whole journey."

"I read some information related to computer attacks from the Internet. I believe that EMR is vulnerable to these kinds of problems…"

4.2.3.5 Factors Impacting Users' Belief toward Improved Patient Care Outcomes

The researcher found that the sensory experience (users' perception) of EMR users can influence users to believe that EMR is useful system to improve patient care. For example, 19% of participants perceived EMR as a user-friendly system. They perceived that EMR system was not complex system and can be beneficial in their tasks. They believed that this system could improve outcomes and patient care.

'EMR makes my work easier and I can manage my data for each patient consistently ... I believed that I can have more attention on my patient by saving my time.'

In addition, some participants perceived that they lose their autonomy by applying EMR in their work. The data perceived through their sense can impact on their belief.

'Other doctors can access my patients' information and monitor my processes. I have to protect my patient's privacy to know more about privacy standard in EMR. Generally, I reckon EMR is

useful system compare to the traditional systems in the hospital, but we should know more about it'

Finally, 24% of participants perceived privacy breaches in the EMR system. The participants were doubtful that this system is a secure platform to store patient information and they were worried about unauthorized access of information.

'Paper-based medical records are much more secure than computer-based systems. Hackers can attack the system and destroy everything … recently I found that the main server is not located in the local centre, so who access data? After clarifying these concerns, I believe that EMR can be helpful system to complete our tasks because I've seen the results.'

4.3 PHR Study

In this section, the researcher clarify the characteristics of participants in the PCEHR study. After that he measure the proposed model in this research, which was based on the HBM. The next step is to test the hypothesized relationships among the latent constructs in the structural model. As he mentioned in the methodology section, because of resource limitations he divided the participants into two groups.

4.3.1 Descriptive Statistics

Table 4.14 shows the characteristics of the study participants. The majority of participants were women, single and aged between 60 and 69. All participants expressed that they had at least one major chronic condition, including diabetes, heart disease, asthma and allergy. A total of 25.2% of participants in both groups stated that they had other chronic conditions (percentages shown in

both groups) such as glaucoma (1.82%), chronic renal disease (3.64%), epilepsy (2.73%), Parkinson's disease (0.91%), arthritis (2.73%), and cancer (7.28%).

Table 4.14 Characteristics of study participants

	Characteristics	Number (Percentage) of Participants
Age	<60	16 (14.5%)
	60-69	44 (41.2%)
	70-80	32 (29.9%)
	>80	15 (14.1%)
Gender	Female	61 (57.1%)
	Male	46 (42.9%)
Education	Less than high school	17 (15.8%)
	High school	19 (17.7%)
	Some college/diploma	47 (43.9%)
	Bachelor degree	20 (18.6%)
	Master degree or higher	4 (3.7%)
Marital status	Married/partnered	45 (42.1%)
	Single	62 (57.9%)
Chronic condition	Diabetes	16 (14.9%)
	Heart disease	15 (14.2%)
	Asthma	24 (22.4%)
	Allergy	25 (23.3%)
	Other	27 (25.2%)

4.3.2 Measurement and Validation

The measurement model consists of relationships between the conceptual factors and the measures underlying each construct. The measurement model was evaluated through a test of individual item reliabilities, internal consistency and discriminant validity. It is necessary to test that the measurement model has a satisfactory level of validity and reliability prior to testing for a significant relationship in the structural model. Reliability measures the degree to which the set of indicators of a latent variable is internally consistent in its measurements.

Validity is the extent to which a scale or set of measures accurately represents the concept. The two major dimensions for testing the measurement model are convergent validity and discriminant validity. Convergent validity measures the degree to which items on a scale are in theory linked, which is usually measured by the average variance extracted (AVE). Table 4.15 shows that the AVE of each latent construct is greater than 0.50, a recommended threshold, indicating convergent validity.

Table 4.15 Tests of convergent validity and reliability

Construct	Cronbach's alpha	CR	Alpha	AVE
Perceived susceptibility	0.76	0.89	0.818	0.729
Perceived severity	0.85	0.936	0.901	0.829
Perceived confidence	0.7	0.799	0.629	0.57
Perceived usefulness	0.73	0.85	0.737	0.655
Perceived barriers	0.63	0.928	0.884	0.812
Perceived cues to action	0.77	0.921	0.871	0.794
Usage Intention	0.72	0.857	0.751	0.667

Furthermore, the values of the composite reliability (CR) of the different latent variables range from 0.7985 to 0.9355. These values exceeded the recommended limit of 0.70, indicating an acceptable reliability. Cronbach's alpha is applied to measure the reliability and consistency of the entire scale. Based on Table 4.15, Cronbach's alpha values for all constructs are above 0.70 (the recommended threshold). Furthermore, cross-loadings of all the items in Table 4.16 shows that each within construct item loading is higher on the measured construct than the cross-loadings on the other items, indicating good discriminant validity of the measurement model.

Table 4.16 Factor loadings and cross-loadings

Indicator	PSC	PSV	PC	PU	PB	CA	UI
PSC-1	0.806	0.364	0.421	0.634	0.26	0.369	0.634
PSC-2	0.889	0.427	0.236	0.439	0.453	0.413	0.147
PSC-3	0.864	0.369	0.632	0.423	0.413	0.236	0.367
PSV-1	0.498	0.939	0.453	0.343	0.634	0.32	0.416
PSV-2	0.369	0.938	0.463	0.63	0.324	0.412	0.703
PSV-3	0.536	0.852	0.634	0.264	0.632	0.154	0.154
PC-1	0.458	0.345	0.823	0.165	0.523	0.185	0.36
PC-2	0.698	0.624	0.725	0.642	0.124	0.356	0.698
PC-3	0.368	0.326	0.712	0.344	0.423	0.269	0.428
PU-1	0.547	0.124	0.423	0.823	0.439	0.365	0.145
PU-2	0.367	0.478	0.638	0.725	0.326	0.487	0.169
PU-3	0.458	0.487	0.426	0.712	0.417	0.169	0.498
PB-1	0.398	0.234	0.532	0.135	0.904	0.136	0.146
PB-2	0.367	0.127	0.632	0.645	0.926	0.268	0.652
PB-3	0.423	0.189	0.36	0.154	0.827	0.425	0.236
CA-1	0.417	0.634	0.638	0.349	0.364	0.915	0.145
CA-2	0.602	0.354	0.245	0.631	0.274	0.864	0.38
CA-3	0.465	0.512	0.537	0.234	0.354	0.895	0.567
UI-1	0.567	0.369	0.467	0.049	0.278	0.383	0.858
UI-2	0.265	0.684	0.412	0.634	0.365	0.145	0.833
UI-3	0.439	0.413	0.369	0.327	0.243	0.368	0.756

Note: usage intention (UI), cues to action (CA), perceived susceptibility (PSC), perceived barriers (PB), perceived confidence (PC), perceived severity (PSV), perceived usefulness (PU).

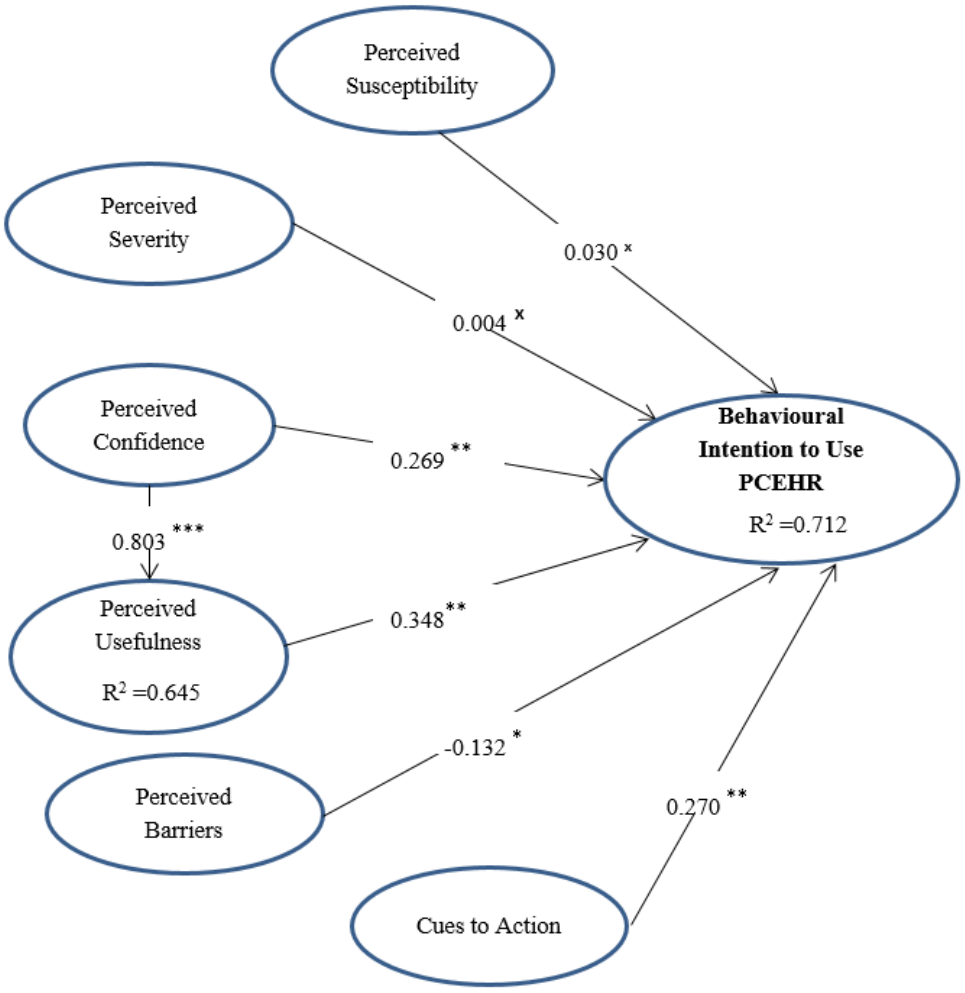
Discriminant validity measures the extent to which a construct or variable is distinct from another variable or construct. A satisfactory discriminant validity is demonstrated when a construct shares more variance with its measures (indicators) than with other constructs in the same model. Since the square roots of the AVE are significantly higher than correlations between constructs in the corresponding rows and columns, the instrument demonstrates adequate discriminate validity, as presented in Table 4.17.

Table 4.17 Test of discriminant validity

	UI	CA	PSC	PB	PC	PSV	PU
UI	**0.816**						
CA	0.686	**0.891**					
PSC	0.272	0.16	**0.853**				
PB	0.541	0.417	0.182	**0.9**			
PC	0.711	0.687	0.259	0.548	**0.755**		
PSV	0.353	0.467	0.049	0.278	0.383	**0.91**	
PU	0.775	0.63	0.324	0.469	0.703	0.302	**0.809**
Note: usage intention (UI), cues to action (CA), perceived susceptibility (PSC), perceived barriers (PB), perceived confidence (PC), perceived severity (PSV), perceived usefulness (PU). Bolded diagonal elements are the square roots of average variance extracted (AVE)							

4.3.3 Testing the Structural Model

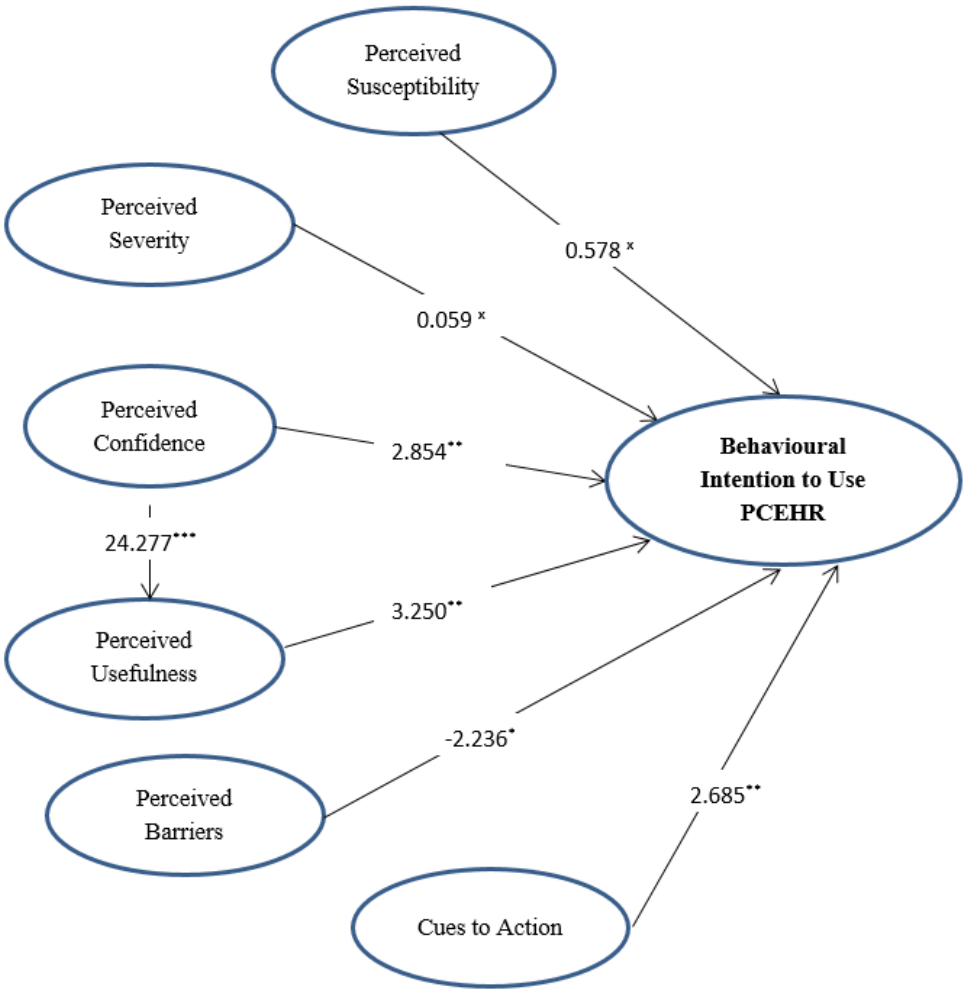
The structural model provides information as to how well the theoretical model anticipates the hypothesized paths or relationships. It is estimated by the path coefficients and R^2 values, as presented in Figure 4.7. R^2 indicates the percentage of variance in the corresponding construct that is clarified by the structural paths leading to it. The strengths of the relationships between constructs are indicated by the path coefficients. Perceived confidence had a significant effect on perceived usefulness. The path coefficient was 0.803 and accounted for 64.5% of the variance of perceived usefulness. Overall, the model explains 71.2% of the variance in usage intention, as indicated by the R^2 value.



Note: * Significant at 0.05; ** Significant at 0.01; *** Significant at 0.001; x =not significant

Figure 4.5 Results from Smart PLS analysis (path coefficients)

The test of significance of all paths was done applying the bootstrap resampling procedure (500 subsamples), a nonparametric technique for the assessment and estimation of the precision of the PLS. Figure 4.6 presents the summary of PLS analysis based on t-values.



Note: * Significant at 0.05; ** Significant at 0.01; *** Significant at 0.001; x =not significant

Figure 4.6 Summary of PLS analysis (t-values)

The test statistic shows whether the relationship is statistically different to zero and the results are reported in Table 4.18. The t values should be significant to support the hypothesized paths. The bootstrapping results were used for each of the hypotheses. All the hypotheses were supported except for perceived susceptibility (H1) and perceived severity (H2). The results show that neither

perceived susceptibility nor perceived severity directly predict an intention to use the PCEHR. Thus, five out of seven hypotheses were supported.

Table 4.18 Hypotheses testing results

Hypothesis	T statistics	Result
Perceived susceptibility has a positive effect on the usage intention of PCEHR.	0.578	Not supported
Perceived severity has a positive effect on the usage intention of PCEHR.	0.059	Not supported
Perceived confidence has a positive effect on the usage intention of PCEHR.	2.854**	Supported
Perceived confidence has a positive effect on the perceived usefulness of the PCEHR.	24.277***	Supported
Perceived usefulness has a positive effect on the usage intention of PCEHR.	3.250**	Supported
Perceived barriers has a negative effect on the usage intention of PCEHR.	-2.236*	Supported
Cues to action has a positive effect on the usage intention of PCEHR.	2.685**	Supported
* Significant at 0.05. ** Significant at 0.01. *** Significant at 0.001.		

4.4 Summary

This chapter represented the data analysis phase of this study and presented the results of the analysis. In the EMR study, the researcher clarified data analysis approach to analyse data collected from 78 interviews were conducted between August 2013 and September 2014. He categorized the results into ten main themes based on thematic analysis: (1) perceived benefits of EMR; (2) perceived difficulties; (3) hardware/software compatibility; (4) job performance uncertainty; (5) ease of operation; (6) perceived risk; (7) assistance society; (8) users' confidence; (9)

organizational support,; and (10) technological support. Furthermore, he analyzed the data based on three phases of grounded theory approach and identified 24 open codes at the first stage.

In the PHR study, the researcher presented the data, which was collected from hands-on PCEHR workshops. After that he measured the proposed model in this research, which was based on the HBM. Finally, the researcher tested the hypothesized relationships among the latent constructs in the structural model.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

5.1 Overview

Chapter 4 showed the data analysis for this research and its findings. This chapter clarifies the findings of the study, provides their implications for theory and practice, and presents research limitations and future research directions.

After this brief overview, Chapter 5 outlines and discusses the answers to the research question related to the EMR study (Section 5.2.1). The researcher clarifies the findings based on thematic analysis and grounded theory approaches. In the next part, he discusses implications for research and practice in EMR studies (Section 5.2.2 and Section 5.2.3) and finally, he clarifies the limitations and future research in EMR (Section 5.2.4).

Regarding the PHR study, he clarifies the results to answer the research question related to the PHR study (Section 5.3.1). He also identifies facilitators and barriers to PHR adoption. After that, he propose implications for research and practice in field of PHR systems (Section 5.3.2 and Section 5.3.3). Finally, the researcher explain the strengths, limitations and future work in PHRs (Section 5.3.4) before offering a summary of EMR and PHR studies in Section 5.4.

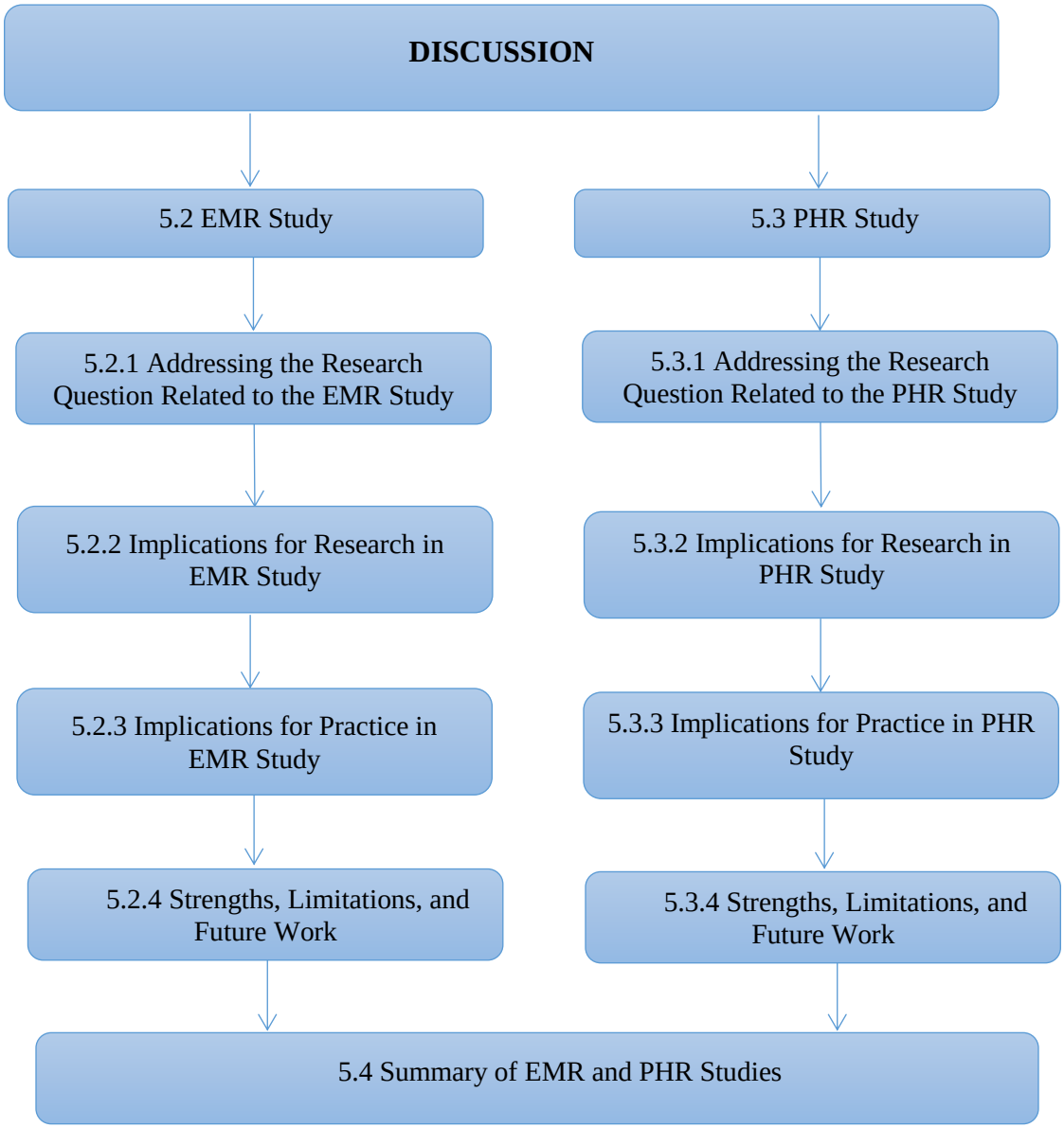


Figure 5.1: The outline of chapter five

5.2 EMR Study

In this section, the researcher clarify the results to answer the research question related to the EMR study. He also identify facilitators and barriers to EMR adoption. After that, the researcher

propose implications for research and practice regarding the EMR systems. Finally, he explain strengths, limitations and future work in EMR research.

5.2.1 Addressing the Research Question Related to the EMR Study

In this part of this thesis, the researcher aim to identify the determinants of the usage intention toward the EMR system. The researcher clarifies the results based on thematic analysis and grounded theory approaches to identify facilitators and barriers to the users' adoption of EMRs.

5.2.1.1 Thematic Analysis

This study provided an in-depth understanding of healthcare professionals' perceptions regarding using EMR. The participants' perspectives and experiences were identified for the ten main themes: (1) perceived benefits of EMRs, (2) perceived difficulties of EMR by users, (3) hardware/software compatibility, (4) job performance uncertainty, (5) ease of operation, (6) perceived risk, (7) assistance society, (8) user confidence, (9) organizational support, and (10) technological support. In this section, the author justify the identified themes based on the current literature.

5.2.1.1.1 Perceived Benefits

According to the results, the researcher observed seven main benefits of the EMR system in the interview transcripts, including improving patient safety, improving quality of care, improving documentation, improving decision-making, improving communication, saving time, and improving prestigious status.

Each healthcare provider indicated that the EMR system has potential benefits compared to paper-based medical records. Some participants believed that EMR can improve quality of care by providing an integrated platform where healthcare providers can connect in order to make a better decisions. This EMR benefit is consistent with the literature regarding the role of this computer-based system in enhancing patient care. Stream (2009) conducted a survey to evaluate the user adoption of health record systems and reported that the system can improve patient care quality and safety.

Participants also believed that other benefits of the EMR system included improving patient safety, improving decision-making and improving communication. This finding was consistent with EMR literature, which explained that EMRs can improve patient care safety by reducing written and typographic errors in the system (Boaden and Joyce 2006). EMR can bolster clinical decision-making by providing a secure and accessible framework for healthcare providers and administrators in healthcare organizations (El-Kareh et al. 2009; L. Xiao et al. 2011a). EMRs can support communications within the hospitals, doctors can share patient records with other healthcare providers, and it is very useful in the treatment process (Boaden and Joyce 2006).

Other benefits of EMRs were improving documentation, saving time, and improving prestigious status regarding patient care. These findings are supported by Szydlowski and Smith (2009). They indicated that EMRs can improve documentation in hospitals by providing a user-friendly digital format and decreasing medical errors when importing medical data. EMRs can save the time of healthcare providers by providing useful features such as searching data, sorting information based on data/time and filtering medical records based on patient IDs (Karsh et al. 2004). Al-Jafar (2002) believed that EMRs can improve the image and prestige of healthcare providers in the hospital, and help them feel that they are valuable to their patients and to the

healthcare team. The nature of these benefits and their roles in the construct of individual attitudes, suggest that perceived benefits will play a positive role in attitudes towards the use of EMR systems.

5.2.1.1.2 Perceived Difficulties

The researcher observed that perceptions of EMR difficulties were associated with issues such as the overall complexity of the system, hardware/software problems, and time for documentation. Some participants believed that the EMR system is complex and they had to spend more time performing regular tasks. They complained about EMR features such as the documentation modulus, interface issues, lack of customizability, and the reporting system. These findings can be generalized to provide a user-friendly and less complex system that healthcare providers can apply in their tasks. The majority of healthcare providers do not have mid-level or advanced-level computer knowledge, so system designers should develop a system that is easy to use for everyone in healthcare organizations (Rogers 1962, 2010). According to the literature, the greater the perceived ease of use of EMRs by healthcare providers, the greater the user adoption of the system (J.-S. Li et al. 2012; Rose et al. 2005).

One of the major barriers to the user adoption of EMRs is hardware/software issues. Some participants reported system-related problems with EMRs. These can be different from one system to another, but the main root is system infrastructure problems. These kinds of problems can be related to data storage, data retrieval, data sharing procedures, power outages, portable devices, down time, networking or connectivity, and compatibility of software with hardware The speed of EMR functionality related to how fast information loads on the screen, for example, is essential for healthcare providers, and slow response can hinder EMR adoption (Noteboom et al. 2012).

Finally, some participants complained about the time required to import paper-based data into EMRs. They believed that they should focus on patient issues instead of spending their time on documentation. They confessed that they do not have sufficient keyboard/mouse skills to enter medical data into EMRs. This finding was consistent with the literature, which recommended that optimized documentation procedures should be designed to improve the communication of patient data, enhance access to medical data, decrease errors, format a data repository for management purposes, and finally reduce paper-based medical data (Terry et al. 2008; Walter and Lopez 2008). Some researchers emphasized that EMR data entry is time-consuming and cumbersome due to the complexity of the system and inability of healthcare providers to handle it (Albert Boonstra and Broekhuis 2010b; Loomis et al. 2002; Rahman and Ko 2012). The nature of these problems and their role in individual attitudes, suggests that perceived difficulties will play a negative role in attitudes towards the use of EMR systems.

5.2.1.1.3 Hardware/Software Compatibility

In the transcripts, system integration with other IT systems was noted by some participants, who believed that the ability of EMRs to connect to the other computer-based system in the hospital can motivate users to apply EMRs in their tasks. According to the literature, the integrated EMR system can provide a patient-centric platform that enables operational efficiencies and supports more effective communication between healthcare providers and staff throughout a hospital. EMRs can connect with portable devices to monitor and maintain patient data such as blood pressure, allergies, and heart rate (Choi et al. 2011; Heinze et al. 2011; Masys et al. 2012). This can play a positive role in motivating healthcare professionals to adopt EMRs in their tasks.

5.2.1.1.4 Job Performance Uncertainty

The next theme was job performance uncertainty. It appeared in two main contexts: concern about user autonomy and overall system uncertainty. According to the literature, performance expectancy is an essential psychological factor that impacts users' behavioral intention. Individuals should believe that applying the specific system can help them to complete tasks, and be motivated to adopt the system (Venkatesh et al. 2011).

Some participants believed that EMRs can have a negative impact on their control over their patients. They reported that EMRs can provide data-sharing modules in the hospital, so other health givers can change data that they had written. This barrier to EMR adoption was consistent in the literature: physicians often do not perceive a relationship between professional autonomy and EMR use in hospitals (Vishwanath and Scamurra 2007; Walter and Lopez 2008). They believe that EMRs can have a negative impact on the control care givers have over patients (Albert Boonstra and Broekhuis 2010b).

Some participants reported that they had faced different problems when using EMR and that they couldn't trust the system as an accurate and stable platform for storing patient data. They had a fear of system corruption or any system-related problem. According to the literature, users need to trust the backend and structure of a system to use it in their workplace (Saleem et al. 2009). EMR users should trust different aspects of the system such as confidentiality, data integrity, availability, accuracy, and standards (Norm Archer and Cocosila 2009; Becker and Sewell 2004; Albert Boonstra and Broekhuis 2010b).

5.2.1.1.5 Ease of Operation

The fifth theme was ease of operation. It was identified as the degree of ease associated with applying specific systems in the workplace (Dulle and Minishi-Majanja 2011). Some participants believed that using the EMR system was simple in daily tasks. According to the literature, if users perceive that using a system is free from effort and that it is beneficial to manage data, they are more likely to adopt the system (Aaronson et al. 2001; Angst and Agarwal 2009; Harle et al. 2014; McInnes et al. 2006; Winkelman et al. 2005).

5.2.1.1.6 Perceived Risk

The researcher observed two different contexts in this theme: security and privacy concerns (legal), and reluctance to perceive usefulness (psychological risk). Some participants had concerns about security and privacy issues with the EMR system. They were worried about computer crashes, computer viruses and the destruction of patient information by hackers. Some researchers believe that applying computerized medical record systems in hospitals can have a negative impact patient privacy (Jha et al. 2009; Loomis et al. 2002; Winkelman et al. 2005). Healthcare providers are doubtful about whether this system is a secure platform for storing patient information and they are worried about unauthorized access to the information. Physicians are concerned that the disclosure of patient data may cause legal problems (Hewitt 2009; Kemper et al. 2006).

Some participants believed that using paper-based medical records is more efficient compared to the computer-based system. They believed that applying EMRs in the workplace is useless and cannot improve patient care. They reported that new technology brings new problems to the workplace. The main reason that healthcare providers are reluctant to see benefits of EMRs might be technology related. They are worried about changing their life to a new style. They feel fear

and anxiety due to interaction with computer-based systems such as EMRs and PHRs and this fear may be the main threat to EMRs. This context (reluctance to perceive EMR benefits) needs more investigation because there is a lack of research exploring motivational factors in order to highlight EMR benefits in healthcare organizations.

There are also various studies that have highlighted that perceived risk has a negative and significant impact on behavioral intention towards the use of different systems (Norm Archer and Cocosila 2009, 2011; Kesharwani and Bisht 2012; Linder et al. 2006); the researcher cannot find any generalized theory or model that clarifies the relationship between behavioral intention and perceived overall risk.

5.2.1.1.7 Assistance Society

In the interview transcripts, the researcher observed three different contexts related to this theme: colleague support, supervisor support, and top-level management characteristics.

Some participants believed that colleague support has a positive impact on their acceptance of the EMR system. When they face a problem, the first step before calling the EMR technical team or IT department is asking their friends/colleagues who use the system. A supportive attitude from colleagues has a positive impact on EMR users, encouraging them to adopt EMR. Lack of support from colleagues can impede healthcare providers in their further adoption of the EMR system. Some participants also reported that their experience of top management support motivates them to use EMR. Supervisors in each department can motivate ordinary users and provide workshops and training to determine current user needs (McIntire and Clark 2009). Managers can motivate users by providing incentives and awards (Lluch 2011) .

Some participants believed that top-level management characteristics can have a positive impact on user adoption of the EMR system, however, there are various studies in different contexts that emphasize the role of managers in the adoption of technology (Gostick and Elton 2007; Menachemi et al. 2004; Reich and Benbasat 2000; Storey and Salaman 2009). There is a lack of research exploring the role of top-level manager characteristics in motivating employees to use EMR. Managers who are more innovative, information seeking, and knowledgeable about computer-based systems are more likely to adopt IT computer technologies. Top-level managers can impact the implementation and acceptance of new technologies. They can review IT plans, monitor results, and solve management and technical problems. They can provide policies and standards to encourage IT use and better user performance (Fink 1998).

5.2.1.1.8 User Confidence

In the interview transcripts, the researcher observed that some participants felt their self-efficacy helped them to change their tasks to adopt the new system. Willingness to change/openness to change was reported by some of participants as the main motivation to use EMR. These kinds of behavior fit with the self-efficacy feature of confidence to change their tasks for a better life. These participants were willing to contribute to improving the quality of care in hospitals. Actually, they are information seeking in order to find new technologies and modules to help them in their tasks (Albert Boonstra and Broekhuis 2010b). There is a lack of EMR research investigating factors that motivate people to accept to innovative technologies (willingness to change).

5.2.1.1.9 Organizational Support

According to the interview transcripts, some participants in this study reported that professional development programs can help healthcare professionals use computer-based systems such as EMRs in hospitals.

Professional development opportunities can range from various formal types of vocational education, group or individual learning workshops, single training sessions and semester-long workshops. The positive impact of professional development on user adoption and acceptance has been identified in the literature. Individuals such as teachers, military officers, healthcare providers and engineers are interested in professional development programs to improve professional skills, to enhance work progression, to overcome problems in the workplace, and to comply with the professional regulations of organizations. For example, Wozney et al. (2006: 195) noted that 'professional development must attend to the enhancement of teachers' expectations of success. Teachers need to believe that they can successfully implement the innovation within their own context; if not, they may neither take the initial risk nor continue to persevere in implementing it.' It is essential to explore the effect of professional development programs on individual attitudes to accepting new technology such as EMRs.

5.2.1.1.10 Technological Support

The final theme was technological support. The researcher observed two main contexts in the interview transcripts: technical support and technical training. Some participants reported that technical support is an important driver of EMR use in the hospital. According to the EMR literature, early strategies to train health providers to use EMR are important and must be tailored to their knowledge, competence and motivation during transition from a paper-based system to

EMR. Technical support from IT departments and EMR professional teams should be ongoing after EMR implementation (Ludwick and Doucette 2009; L. Xiao et al. 2011a).

Some participants believed that technical training and workshops were factors that supported EMRs in hospitals. This finding was consistent with the literature, which explained that technical training in various formats such as classroom training, online forum, e-learning, and various interactive online learning modules, can help healthcare providers to adopt EMRs in their workplace (Urban et al. 2012; L. Xiao et al. 2011a). In the context of the user, the adoption of EMR systems, technical support infrastructure and technical learning programs are important issues because a lack of these factors as facilitating conditions can inhibit the user adoption of EMR.

5.2.1.2 Grounded Theory

In accordance with the grounded theory approach, the data analysis was performed in three major phases. In the first phase (open coding), the researcher read all transcripts several times and assigned a code to each phrase. The open codes were generated from the data itself, applying a line-by-line coding strategy. This approach helps to identify gaps, define actions and explicate both actions and meanings and leads to developing theoretical clusters. This stage takes time to review all codes and he merged or deleted some codes based on their concepts and meanings. In the second phase (axial coding), he attempted to make relationships and links between open codes. The researcher categorized all codes according to their meanings. Finally, in the last phase, as a selective coding, he linked all categories/themes and selected a focal core theme. The researcher explained the relationship of other themes with this central theme and proposed the storyline based on the core theme. From the results, the researcher found that healthcare professionals with higher

levels of awareness of EMR have a more positive perception toward using EMRs. This positive perception plays an important role on users' beliefs about the advantages EMR in the hospitals. If healthcare professionals believe that EMR can improve quality of care and patient safety, they have more intentions to adopt the system. In this section, the researcher clarifies the results based on literature in three separated parts: user awareness, user perception, and user belief toward improved patient care outcomes. Figure 5.2 presents the proposed flowchart based on users' awareness, users' perception, and users' belief to increase the intention to adopt the EMR system.

First of all, the researcher can focus on users' awareness towards the use of EMR. Healthcare professionals with higher level of awareness of EMR have more positive perception toward using EMR (Route #1). If users do not have appropriate level of awareness/knowledge towards the use of EMR, there are some ways that can be helpful based on the results of this study (Route #2). For example, professional development programs are helpful in educating users about new information (Fracker 1991). People, such as healthcare professionals, military officers, and engineers, are interested in these kinds of programs to improve professional skills, enhance work progression, overcome problems in the workplace, or to comply with the professional regulations of organizations (DeSantis 2013; Doherty 2011; Wozney et al. 2006).

Furthermore, technical training has a positive role on increasing users' understanding of system functionality. Technical training can be in various formats, such as classroom training, online forums, e-learning, and different interactive online learning modules to help healthcare professionals adopt EMR in their workplaces (Urban et al. 2012; L. Xiao et al. 2011a).

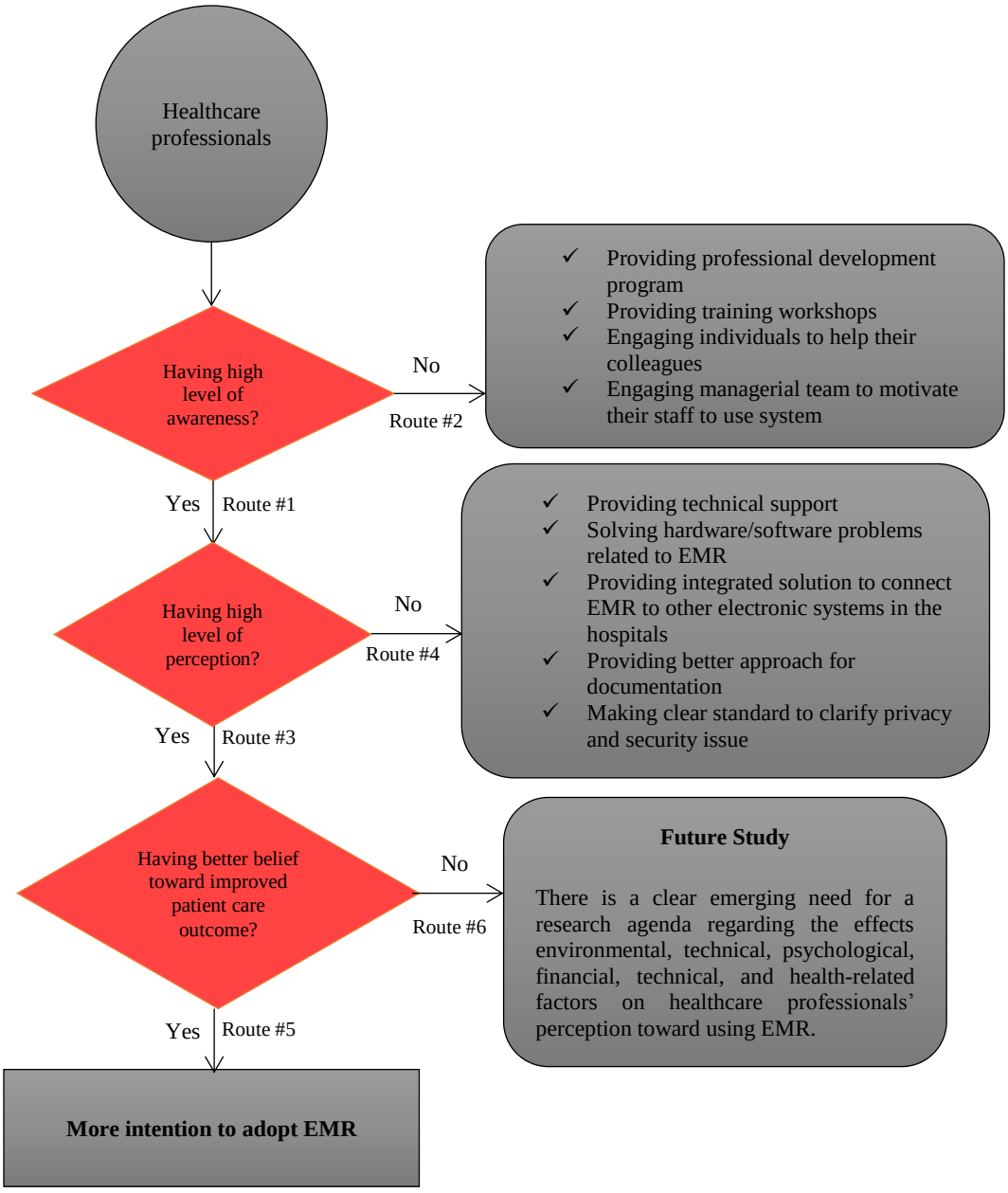


Figure 5.2 Proposed flowchart to increase the intention to adopt of EMR

If healthcare policymakers and managers support an EMR system by providing workshop and training sessions within the health organization, they can promote EMR dissemination and increase users 'awareness (Wilkins 2009). Users need to increase their use of the system and they may optimize their usage of key functions by attending training sessions. In addition, some participants

showed that if they have more computer knowledge and more experience with computer-based systems in healthcare sectors, they know more about the benefits of the system and its functionality. This finding is supported by the literature, which explained that EMR users who have more confidence and computer knowledge regarding computers and the Internet are happier using the system (Hier et al. 2005; McNeil et al. 2006; Munir and Boaden 2001). In addition, some participants stated that if they have a more supportive team (colleagues, supervisors, or managers), they have more motivations to learn about EMR. Supportive team members are helpful in encouraging users to learn about the system and overcome any issues with the system (Lluch 2011; McIntire and Clark 2009). Having a supportive team member in the organization has been highlighted in the literature as part of the concept of organizational culture (Davies et al. 2000; Martins and Terblanche 2003; Parker and Bradley 2000). If people in the organization have shared assumptions, values and beliefs, they have better collaboration, which is helpful in achieving organizational goals. In the EMR context, if users increase their knowledge regarding the use of the system, they can help their colleagues perceive the benefits of the system, motivating them to accept EMR.

The second part is related to the users' perception toward the use of EMR. There were different factors impacting user perception of EMR systems. The researcher can divide all responses related to user perception into two distinct parts. Some participants were open (positive perception) to use EMR and they had faith in the system (Route #3). These participants that were willing to change had prior experience with EMR systems in different healthcare sectors and they knew about the benefits of the system. They wanted to know more about the system and they perceived EMR as a user-friendly system that can be integrated with the different computer-based systems in the hospital. According to the literature, the change process is a fundamental issue that can impact

users willingness to accept the system (Lin et al. 2012). Comprehensive change management is needed to understand the users' needs to overcome resistance to EMR adoption (Ibrahim and Don ; Randeree 2007). The researcher found that the positive perceptions play an important role on users' beliefs about EMR benefits.

On the other hand, some participants expressed that they were reluctant to accept EMRs because of different reasons, including the perception that EMR is useless, that the system can waste their time, that there can be problems with the initial data entry, that it is not a user-friendly system, that there are security and privacy breaches, that EMR is not reliable system, or lack of customization. There were some technical contexts, such as time needed for documentation, hardware/software problems, and system complexity, which can have negative effects on the users' perceptions. This finding was consistent with the literature, which explained that if users face various problems while working with the system, they perceive that the system is useless and they are reluctant to use it (Ankeny 1991; Van Deventer 2009). To solve this issue (Route #4), user awareness should be increased by providing technical trainings and professional development programs (DeSantis 2013; Doherty 2011; Wozney et al. 2006). For example, IT professionals can promote initial and sustained EMR adoption if they collaborate with physicians in planning initial and ongoing support (Fenton et al. 2006). Moreover, EMR system developers should have a stronger focus on customization (Bennett 2012; Albert Boonstra and Broekhuis 2010b). For instance, physicians have no interest in predefined letter templates, preferring to use their own format in which forms of letters can be adjusted. It is important to develop EMR systems with the customization options that healthcare providers can adjust them based on their opinion (Albert Boonstra and Broekhuis 2010b). Moreover, ergonomic considerations have a significant role in users' perception (M. Najaftorkaman et al. 2013a). For example, lighting conditions and the quality

of monitors in offices and exam rooms vary, and user interfaces can be difficult to use. Portable devices are useful in clinical workflows. Some of the devices currently available have usability problems running EMR applications such as touch screens that do not work properly, and memory and processor issues, and are in need of improvement (Gatzoulis and Iakovidis 2007). These issues should be helpful to increase negative perceptions of healthcare providers towards the use of EMR.

In the last part, the researcher focused on healthcare professionals' belief toward using EMR. The majority of participants believed that EMR is a beneficial system for improving patient care. These participants perceived the benefits of EMR, such as improving patient safety, quality of care, documentation, decision-making, communication, and time management. According to the Theory of Reasoned Action (TRA) individuals' beliefs can influence on the intention of system adoption (Fishbein 1979). Individuals who have more positive beliefs toward using EMR have more intentions to use the system (Route #5). On the other hand, participants that perceived EMR as a useless system have negative beliefs about EMR and are reluctant to adopt the system. According to the literature (Del Val et al. 1997; Shoham and Del Val 1991), there are two different types of perceptions that can impact an individual's belief: sensory perception and psychological perception. Sensory perception involved looking at a specific situation with the help of sense organs, such as eyes, ears, nose, tongue and skin. On the other hand, psychological perception is the use of the mind and the central nervous system (CNS) to achieve a complete outlook of the specific matter. If individuals perceive that a particular system is useless, based on their experience and observation, this feeling of perception directly negative impacts the individual's beliefs on the system, leading to hinder to adopt the system (Del Val et al. 1997; Smith 2001). There is a clear emerging need for more research to identify factors to ameliorate the effect of negative belief toward using EMR (Route #6). It is a good idea to investigate the effects of environmental,

technical, psychological, financial, technical, and health-related factors on healthcare professionals' perception and belief toward using EMR in the future study (M. Najaftorkaman et al. 2013a).

5.2.2 Implications for Research in EMR

This exploratory EMR case study has some major implications for researchers. According to the data analysis procedure, the researcher extracted some contexts of EMR adoption that need further research. These contexts include the effectiveness of professional development programs, user willingness to change, the effect of EMR on the institution's prestige status, concerns about losing user autonomy, reluctance to perceive usefulness (psychological risk), and the effects of top-level management characteristics.

There are some prestigious studies that have included these contexts relative to health information systems. Thus, researchers should evaluate these contexts in future EMR research because there are various health information systems, each having a different structure and function. For example, Lorenzi and Riley (2000) evaluated the change management of health information systems in healthcare organizations. They reported that major challenges in change management for system success are often more behavioral than technical. Successfully introducing such systems into complex healthcare organizations requires an effective blend of good behavioral, technical and organizational skills (Lorenzi and Riley 2004). Yusof and colleagues (2008) reported that having the right user attitude and skills base, together with good leadership, an IT-friendly environment and good communication, can have a positive influence on the adoption of health information systems in healthcare organizations.

Some participants identified professional development programs as a useful organizational factor to assist EMR users in adopting the system in their workplace. They reported that professional development programs in hospitals can support healthcare professionals in using clinical and computer-based systems. In the interview transcripts, the researcher observed that some participants were willing to change and accept new systems in the hospital. They trusted the system and believed that EMR has potential benefits related to their tasks. They were open to adopting the new system and they had the confidence to accept new technology to help them in their practices. As a result, they were excited and passionate about the future of their profession.

The researcher also observed that working in a hospital that uses the latest medical record technologies can improve the status in users in the healthcare profession. They felt that using EMRs could save time so that they would be more productive healthcare professionals compared to those who use traditional (paper-based) systems. Some users, however, also believed that EMR could interfere with their control over the conditions and procedures in their work. They had concerns about losing their autonomy to make decisions based on patient information in EMRs because some information in this system is sharable and other healthcare professionals can access patient data.

Another factor that requires further research was the reluctance to perceive usefulness (psychological risk). Some participants believed that using new technologies in the workplace creates new problems for end-users. According to the results of this study, one of the most important reasons for thinking that the disadvantages of EMRs outweigh the benefits involves technology-related concerns. The participants feel fear and anxiety regarding interactions with technologies such as EMRs and PHRs, and this fear can be a major threat to the adoption of EMRs. Researchers should focus on the effect of top-level management in engaging others in the

organization to adopt new technology such as EMRs. In future research, the researcher should look for solutions to engage managers to accept EMRs since engaged senior managers are more likely to build engaged personnel teams.

5.2.3 Implications for Practice in EMR

This thesis provides important contributions to practice in terms of system design and development, professional development programs, colleague support systems, technical training, and engaging managerial teams to motivate their staff to use the system.

5.2.3.1 Implications for System Designers and Developers

According to the findings of this thesis, healthcare professionals with higher levels of perceived benefits of the EMR are more likely to adopt the system in their workplaces. They believed that EMR brings more benefits relative to their tasks, such as improving patient safety, quality of care, documentation, decision-making, and communication, as well as saving time and improving the institution's prestige status. On the other hand, some of the participants believed that by using EMR, they face more complex problems in their work. They complained about EMR features, such as the documentation modulus, interface issues, lack of customizability, the reporting system, overall complexity of the system, hardware/software problems, and time needed for documentation. These can be different from one system to another, but the main root is system infrastructure problems. These types of problems can be related to data storage, data retrieval, data sharing procedures, power outages, portable devices, system down time, networking or connectivity, and compatibility of software with hardware**.** Consequently, system designers and developers must consider incorporating features that are of importance to the individuals using the EMRs. They should develop a system that has ideal characteristics, such as correctness, usability,

integrity with other systems in the health organizations, reliability, efficiency, security, and safety. EMRs should have the ability to exchange information with other applications and make use of information transparently.

In addition to the above aspects, users also require personalized features in their EMR systems. For instance, physicians have no interest in predefined letter templates, preferring to use their own format in which form letters can be adjusted. Second, ergonomic considerations play a significant role in EMR adoption. For example, lighting conditions and the quality of monitors in offices and exam rooms vary, and user interfaces can be difficult to read. Finally, portable devices are useful in clinical workflows. Some of the devices currently available have usability problems running EMR applications, including touch screens that do not work properly, as well as memory and processor issues, and are in need of improvement.

5.2.3.2 Implications for Healthcare Policymakers

The researcher found that professional development programs have positive effects on user adoption of EMR systems. By conducting ongoing professional development, an organization ensures that it has the skills and capabilities needed and that all individuals are making the best contribution possible. Individuals who participate in professional development programs often demonstrate willingness to change and adopt new systems. Therefore, policymakers can provide professional programs to improve self-efficacy of employees regarding use of the system, as well as to reduce perceived risks of the system and improve individuals' trust in the system.

5.2.3.3 Implications for Top-level Managers

Top-level managers can apply the arguments and empirical insights about EMR benefits, such as patient safety improvement, better documentation techniques, better decision-making in healthcare organizations, better communication between healthcare professionals while making decisions, and increased time savings, as justifications for considering EMRs as a beneficial IT solution, as well as for increasing staff awareness of the advantages and disadvantages of the use of EMRs in the healthcare sector. Top-level managers have an important role in promoting EMR acceptance by formulating guidelines before, during and after EMR implementation. They should work closely with EMR users to provide information management plans that cover users' needs and support clinical workflows. In evaluating EMR users' needs, top-level managers must formulate criteria for assessing and selecting EMR systems for specific purposes.

5.2.3.4 Implications for IT Professionals

Healthcare organizations should organize group or individual workshops to teach employees about the new technology. According to the results of this study, the majority of participants had concerns about various functions of the system. They felt that EMRs could potentially interfere with their autonomy and negatively impact the security and privacy of patients. By organizing these types of development programs by IT professionals, healthcare professionals such as doctors and nurses can be encouraged to accept EMR systems. Personnel need to increase their use of the system and attending training sessions may allow them to optimize their usage of key functions. IT professionals can promote initial and sustained EMR adoption if they collaborate with physicians in planning initial and ongoing training.

5.2.3.5 Implications for Health Professionals

Health professionals with higher levels of awareness of EMR have a more positive perception toward using EMRs. If users do not have an appropriate level of awareness/knowledge regarding the use of EMRs, there are some ways that were found to be helpful based on the results of this study. Colleague support can play an important role in improving awareness regarding use of the system. If people in the organization have shared assumptions, values and beliefs, they have better collaboration, which is helpful for achieving organizational goals. In the EMR context, if users increase their knowledge regarding the use of the system, they can help their colleagues perceive the benefits of the system, motivating them to accept the EMR.

5.2.4 Strengths, Limitations, and Future Work

This EMR study has some limitations. The first involves the small number of hospitals in this study. The time and energy requirements associated with qualitative studies pose significant barriers to large-scale research studies and limit the ability to generalize results across settings with diverse organizational characteristics or market constraints. Nevertheless, the results from the in-depth exploration based on the grounded theory can now be further investigated and validated in larger samples, applying surveys developed based on the findings. Next, even though the sample was precisely selected, the researcher cannot say whether or not it was representative of the whole EMR user population. However, the fact that the interviews expressed both positive and negative perceptions towards the use of EMRs means that the researcher captured a range of experiences, strengthening the findings. Finally, from the qualitative data, he proposed a theory based on grounded theory. Future research should be done to evaluate the significance of EMR users'

awareness on their perceptions and beliefs. It will be helpful to conduct a qualitative study to assess the significance of these factors on EMR user adoption.

5.3 PHR Study

This part of this thesis aims to identify determinants of the usage intention toward the PCEHR. In this section, the researcher clarifies the results to answer the research question related to the PHR study. The researcher also identify facilitators and barriers to PHR adoption. After that, he propose implications for research and practice regarding the PHR systems. Finally, the researcher explain the strengths, limitations and future work in the area of PHRs.

5.3.1 Addressing Research Question Related to the PHR Study

Contrary to the prediction, perceived susceptibility and perceived severity were not found to affect the usage intention toward the PCEHR. One explanation for the lack of support of the direct effect is that the sample was drawn from older adults. The majority of seniors generally have technology (computer) anxiety and do not know the benefits of using technology in their personal lives (McMurtrey et al. 2011, 2012; Mitzner et al. 2014). If seniors perceived a risk or a chance of contracting a health disease or condition (perceived susceptibility) and they think a specific disease or condition is serious (perceived severity), they get stuck in a situation where technology anxiety exacerbates their condition. Older adults are generally worried about making mistakes on computer systems and destroying information, especially in sensitive tasks related to their health (Chu et al. 2009; Henderson et al. 1995; Wild et al. 2012).

The findings for perceived confidence confirm the researcher's prediction. According to the literature (Anderson et al. 2000; Lorig et al. 2000), perceived confidence (self-efficacy) is related

to an individual's belief in their ability to succeed in a particular situation. Self-efficacy plays an important role in chronic disease self-management (Holman and Lorig 1992). If individuals have more self-efficacy, they are more motivated to manage their health conditions. For example, Mohebi et al. (Mohebi et al. 2013) proved that there is a direct relation between self-efficacy and self-care in patients in a way that this construct owns the predictability power of self-care behavior. One of the most important parts of the PCEHR is the Personal Health Notes section, which allows individuals to store private notes about their health. The participants uploaded their medical histories, medication and important notes related to their own health. Furthermore, the Personal Health Summary section allows individuals to enter information about their own health and share it with their healthcare providers. They uploaded their allergy information, adverse reactions, and information related to their own medications. The participants perceived self-efficacy as a positive factor that impacted their intention to use the PCEHR and to share their information with healthcare providers based on the personal functions of the PCEHR.

Furthermore, the findings of the effect of perceived confidence on perceived usefulness confirms the findings of a previous study. Based on the literature (Bandura 1977; Igbaria and Iivari 1995), if individuals have self-efficacy, they perceive the system to be easy and useful because of the effect of self-efficacy on the degree of effort, the persistence and the level of learning which takes place, and they will be less resistant to changes. If individuals have more self-efficacy, they can use the PCEHR regularly and interact with their healthcare providers. By using the PCEHR, they perceive that the system can reduce medication error, increase identification of drug-to-drug contra-indications that lead to allergies, and also reduce unnecessary tests and procedures.

Among the influential factors, perceived usefulness was found to be the strongest determinant, which is consistent with the findings of prior studies (Ahadzadeh et al. 2015; Tang et al. 2006a).

For example, Amoako-Gyampah (Amoako-Gyampah 2007) stated that user perception of the perceived usefulness affects their intention to use the technology. Participants found that the PCEHR could reduce unnecessary duplicative tests and health services, track chronic conditions in conjunction with multiple providers, provide health-related information in emergencies and when traveling, keep lists of their current medications, and reduce taking inappropriate medication. They also had more information about medication side effects because more information was available in the PCEHR.

As expected, perceived barriers have a negative impact on the PCEHR usage intention. The finding is consistent with previous HBM studies (Carmel et al. 1994; H.-S. Kim et al. 2012). Some participants indicated some concerns with applying self-management activities to manage chronic conditions. They had concerns in uploading new medical documents, checking their medical history, and controlling privacy settings. However, the researcher taught them about the Restricted Settings feature that allows individuals to have significant control over their eHealth record, including choosing who can access information in their eHealth record, setting controls on healthcare provider organization access, applying greater controls to sensitive information and choosing which information is not viewable through their eHealth record.

As expected, cues to action has a positive impact on the PCEHR usage intention. The finding is consistent with previous HBM studies (Ahadzadeh et al. 2015). Participants inserted their medical histories, such as allergies, family history of drug allergies, or other harmful (adverse) drug reactions and side effects, into the Personal Health Notes and Personal Health Summary sections. They were more involved with their health conditions and knew more about their health status (internal trigger) by using the PCEHR in their daily lives. The researcher encouraged the participants to ask their healthcare providers to upload their clinical documents, such as pathology

and diagnostic imaging reports and medication records, into the PCEHR. This kind of interaction between healthcare providers and seniors can act as an external trigger to motivate the senior to apply the PCEHR in their life to improve their chronic conditions. In addition, the researcher provided a booklet that discussed the advantages and disadvantages of using the PCEHR and how the system could improve chronic conditions (external trigger). The results showed that the combination of internal and external triggers had an important positive impact on the PCEHR usage intention.

5.3.2 Implications for Research in PHR

This study has a number of theoretical and practical implications. Theoretically, the research provides a model for clarifying the usage intention toward the PCEHR, which not only improves the theoretical foundation of PCEHR research, but also supports the application of technology adoption theories in the area of PHRs. To the best of our knowledge, this is the first quantitative study in the PCEHR domain that takes into account the perceptions of older adults based on the HBM. The researcher identified and measured several new constructs, including the perceived usefulness, barriers, susceptibility, severity, and confidence, as well as cues to action, to clarify the intention to use the PCEHR. While a number of valuable research studies about the PCEHR have produced remarkable results (Andrews et al. 2014; Kerai et al. 2014), many of these studies have been patient-oriented. Obviously, studies regarding PCEHR focus on the health-related information of individuals who need to monitor and manage their data; however, physicians play an important role in PCEHR adoption. If the usage of the PCEHR is part of an integrated healthcare plan devised by doctors, individuals will be more likely to adopt the system. To derive optimal benefits from the PCEHR, patients and physicians should use the system together as partners. Consequently, more research focusing on the physicians' role in PCEHR adoption is needed.

Furthermore, there are limited studies that evaluate the adoption factors of the PCEHR based on adoption theories (Andrews et al. 2014). In order to more precisely address adoption factors, future research will need to be conducted based on current adoption theories. There are some major adoption theories in the field of information systems that could provide significant antecedents to improving system adoption. For example, the theory of reasoned action presents subjective norms and perceived behavioral control; the unified theory of acceptance and use of technology mostly focuses on performance/outcome expectations, effort expectancy, social influence, and facilitation conditions, and DeLone and McLean's (DeLone and McLean 1992) model, which is based on success concepts, focuses on the quality of the system, service, and information.

5.3.3 Implications for Practice in PHR

In practice, the insights gained from this study can directly benefit both individuals and healthcare providers. As the PCEHR is a governmental program, the Australian government plays a significant role in engaging individuals to use the PCEHR.

5.3.3.1 Implications for the Government

At the base level, the government can determine policies and standards for the major PCEHR contents to communicate with other health systems. The government can also motivate individuals by providing tax deductions for the PCEHR-related costs and provide more funding for related research. The government can create education campaigns to motivate healthcare professionals to use the system due to the professionals' positive roles in PCEHR adoption through their direct work with individuals. Unfortunately, many health providers had concerns about sharing too much health-related information with patients, thus causing the patients unnecessary anxiety. It was generally believed that, because of the complex and technical nature of health data, it would be

easy for an individual unfamiliar with this language (medical jargon) to misinterpret the meanings of medical results and come to the wrong conclusions about the severity of his or her health condition. Furthermore, self-management and health literacy concepts should be taught to individuals at an early stage of life. In the educational system, the advantages and disadvantages of self-management behaviors should be evaluated.

In addition, the government should work more on security and policy standards. A high level of privacy standards regarding information in the PCEHR system could assure individuals that healthcare providers are less likely to behave opportunistically, causing them to make more satisfactory judgments about the advantages of the system. For instance, individuals perceived the PCEHR as a useful system if they had control over sharing health-related information with their physicians and family members. Conversely, they perceived high privacy risks if they felt that they had little control over health-related information collated in the PCEHR system.

5.3.3.2 Implications for Health Professionals

The physician–patient relationship plays an important role in the adoption of the PCEHR system. It is vital to have high-quality care during the diagnosis and treatment process. If an individual applies the PCEHR system as part of an integrated healthcare plan advised by doctors, in collaboration with their patients, with the view of achieving a good relationship, then patients will be more likely to adopt the system. The better the relationship, based on mutual respect, trust and shared values about the patient's diseases and life, the better the amount, accuracy, and integrity of information about the related diseases through the PCEHR system. Healthcare professionals should motivate their patients to upload their health-related information and share it with the healthcare sectors. They should guide their patients to add accurate and valuable

information, such as allergies, medical history, and adverse reactions, in the Personal Health Summary section.

5.3.3.3 Implications for Healthcare Policymakers

Another important obstacle regarding adoption of the PCEHR system is a lack of understanding of the system. To motivate individuals and healthcare providers to adopt the PCEHR system, greater knowledge and understanding is needed about the system and its functions. Previous PHR studies have highlighted the importance of running practical workshops aimed at individuals and healthcare providers, taking into account their learning preferences and the time limitations of their life and work environment (Lorig and Holman 2003). Healthcare policymakers could organize hands-on workshops for individuals and healthcare providers to increase their knowledge about the benefits of the PCEHR system, reduce their concerns, such as those regarding privacy and technical issues, and increase their self-efficacy in using the system.

5.3.3.4 Implications for Individuals/Patients

If individuals believe that applying the PCEHR in their healthcare can help them to improve their quality of care, they will be more likely to adopt the system. The health professionals should present the idea that the PCEHR system can provide them with various benefits, such as reducing the amount of time spent completing documentation, facilitating communication between individuals and doctors, improving the accuracy and integrity of health-related information, increasing the overall safety of individual care, reducing the complexity of individual treatment, and reducing the number of times that an individual asks the same question.

5.3.3.5 Implications for System Designers and Developers

There are some issues that should be considered related to aspects of the system's development. For example, interoperability is an important factor that positively impacts PCEHR adoption. The PCEHR system should have the capability to communicate with other health-related systems (EMR/EHR) and to connect healthcare providers with individuals through a shared information network. In order to decrease the amount of time required of the individual during the initial set-up and data entry, the PCEHR system should be integrated with EMR/EHR systems; a few currently are. Furthermore, incomplete functionality and data entry, data sharing, data validation, and information display methods used by the PCEHR limit the ability of patients to serve as suitable representations of health-related information. For instance, patients with diabetes need to have long-term monitoring and treatment. They also need to check their diet, exercise levels, and medication to avoid any complications. The PCEHR system should be easier to use and provide interactive and easy-to-navigate functions, which will, in turn, make it more likely that the system will be adopted.

5.3.4 Strengths, Limitations, and Future Work

This was the first study to evaluate factors that impact the usage intention toward the PCEHR among older adults based on the HBM. The HBM is one of the patterns of behavioral science theories applied to evaluate health-related problems; it is widely used to clarify the behavior of controlling chronic disease (Ahadzadeh et al. 2015; Das and Evans 2014; Yue et al. 2015). The potential limitations of this study are recognized. First, the sample population included only seniors living on the Gold Coast, Australia. The sample was not representative of the Australian population. A more comprehensive future study is suggested, which should include people of different age groups with health problems (e.g., mental health disorders, gastrointestinal problems, depression, and anxiety). Second, apart from the HBM constructs that were evaluated in this study,

future research should also consider other factors that could be included in chronic disease self-management research, such as vicarious experiences, social persuasion, past experiences, technology anxiety, trust (e.g., security, privacy and accuracy), patient–clinician relationships, and information-seeking. Third, this study represents one intervention (PCEHR) and, thus, may not be able to be generalized to all other PHR systems with different structures in different countries. Finally, future research should encompass healthcare professionals who are using the PCEHR. The PCEHR is a system that involves both patients and healthcare professionals working together. It is critical to evaluate the effectiveness of the system on the job performance of healthcare professionals.

5.4 Summary and Conclusion

As discussed earlier, health informatics brings various benefits to the healthcare system. It contributes to good health for the patient and provides comprehensive tools for representing, accessing and visualizing health data. It can provide comprehensive measurement and visualization of the human body and applies formal models for a better understanding of the functions or workings of the human body. Furthermore, health informatics contributes to health knowledge. This study focused on two important health informatics systems, EMR and PHR. The EMR is a computerized system that provides methods of collecting, storing and displaying health information for application with healthcare professionals. On the other hand, the PHR is a system that gathers the individual's health information from different sources in order to assist healthcare providers in understanding their needs and improving the quality of care.

In the EMR study, it was found that perceived benefits play a positive role in the users' adoption of the system. For example, the healthcare professionals believed that EMR can improve

quality of care by providing an integrated platform where healthcare providers can connect in order to make a better decision, improving patient safety, decision-making and communication. In the PHR study, the researcher found the same result related to the role of perceived usefulness on user adoption. Among the influential factors, perceived usefulness was found to be the strongest determinant. For example, the participants stated that the PCEHR system could reduce unnecessary duplicative tests and health services, track chronic conditions in conjunction with multiple providers, provide health-related information in emergencies and when traveling, keep lists of the patient's current medications, and reduce the risk of the patient taking inappropriate medication. Patients also had more information about medication side effects because more information was available in the PCEHR.

Furthermore, the researcher found that perceived difficulty can have a negative impact on user adoption of the EMR. He observed that perceptions of EMR difficulties were associated with issues such as the overall complexity of the system, hardware/software problems, and the time required for documentation. Some participants believed that the EMR system is complex and they had to spend more time performing regular tasks. They complained about EMR features, such as the documentation modulus, interface issues, lack of customizability, and the reporting system. Moreover, some participants had concerns about security and privacy issues with the EMR system. They were worried about computer crashes, computer viruses and the destruction of patient information by hackers. They believed that applying computerized medical record systems in hospitals could have a negative impact on patient privacy. Some participants believed that using paper-based medical records is more efficient compared to the computer-based system. They believed that applying EMRs in the workplace is useless and cannot improve patient care. In the PHR study, perceived barriers were found to have a negative impact on the PCEHR usage

intention. For instance, some individuals indicated concerns with applying self-management activities to chronic conditions. They also had concerns with uploading new medical documents, checking their medical history, and controlling privacy settings.

Moreover, the researcher observed in the EMR study that some participants felt their self-efficacy helped them to change their tasks to adopt the new system. Willingness to change/openness to change was reported by some of participants as the main motivation to use EMR. These types of behaviors fit with the self-efficacy feature of "confidence to change their tasks for a better life". These participants were willing to contribute to improving the quality of care in hospitals. Similar results were obtained in the PHR study. If individuals have more self-efficacy, they will likely be more motivated to manage their health conditions and adopt the PHR system. The researcher observed that individuals who had more self-efficacy had more interaction with the system and were eager to upload their medical histories, medication lists and important notes related to their own health in the PHR system. The participants perceived self-efficacy as a positive factor that impacted their intention to use the PCEHR and to share their information with healthcare providers based on the personal functions of the PCEHR.

In addition, in the EMR study, a supportive attitude from colleagues was found to have a positive impact on EMR users, encouraging them to adopt the EMR. Likewise, a lack of support from colleagues can impede healthcare providers in their further adoption of the EMR system. When the participants face a system problem, the first step before calling the EMR technical team or IT department is asking their friends/colleagues who use the system. In the PHR study, one of the most important aspects of the HBM involved cues to action, which is the stimuli necessary to trigger the decision-making process to accept a recommended health action.

They can be internal, such as when an individual experiences a health problem, or external, for example, communication through the media or with others who have the ability to influence the individual, such as friends and family members. The researcher encouraged the participants to ask their healthcare providers to upload their clinical documents, such as pathology and diagnostic imaging reports and medication records, into the PCEHR.

This type of interaction between healthcare providers and the elderly patients can act as an external trigger to motivate the individual to apply the PCEHR in his or her life to improve chronic conditions. In addition, a booklet was provided that discussed the advantages and disadvantages of using the PCEHR and how the system could improve chronic conditions (external trigger). The results showed that the combination of internal and external triggers had an important positive impact on the PCEHR usage intention.

Finally, at the end of this chapter, implication for research and practice has been clarified. Table 4.19 shows the summary of implication for practice in the EMR and PHR studies.

Table 4.19 Summary of implications for practice in EMR and PHR studies

Implications for practice	EMR	PHR
Implications for system designers and developers	- Providing more stable infrastructure (data storage, data retrieval, data sharing procedures, power outages, portable devices, system down time, networking or connectivity, and compatibility of software with hardware) - Focusing on customizability - Improving business logic and procedure - Improving connectivity with other systems in the healthcare organizations	- Improving interoperability issue(capability to communicate with other health-related systems such as EMRs) - Providing more suitable representations of health-related information - Improving data entry, data sharing, data validation
Healthcare policymakers	- Providing professional programs to improve self-efficacy of healthcare professionals regarding use of the EMR system, as well as to reduce perceived risks of the system and improving individuals' trust in the system	- Organizing hands-on workshops for individuals and healthcare providers to increase their knowledge about the benefits of the PCEHR system, reduce their concerns, such as those regarding privacy and technical issues, and increase their self-efficacy in using the system
Top-level managers in the healthcare organizations	- Applying the arguments and empirical insights about EMR benefits as justifications for considering EMRs as a beneficial IT solution, as well as for increasing staff awareness of the advantages and disadvantages of the use of EMRs in the healthcare sector	
IT professionals in the healthcare organizations	- Organizing group or individual workshops to teach employees about the new technology and functionality	

Table 4.19 Summary of implications for practice in EMR and PHR studies (continued)

Implications for practice	EMR	PHR
Health Professionals	- Colleague support in the healthcare organisations can play an important role in improving awareness regarding use of the system. If people in the organization have shared assumptions, values and beliefs, they have better collaboration, which is helpful for achieving organizational goals.	- If an individual applies the PCEHR system as part of an integrated healthcare plan advised by healthcare professional such as GPs, in collaboration with their patients, with the view of achieving a good relationship, then patients will be more likely to adopt the system.
Government		- Determining policies and standards for the major PHR contents to communicate with other health systems - Motivating individuals by providing tax deductions for the PCEHR-related costs and provide more funding for related research - Creating education campaigns to motivate healthcare professionals to use the system due to the professionals' positive roles in PHR adoption through their direct work with individuals - Working more on security and policy standards

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Appendix A. INTERVIEW GUIDE FINAL VERSION

1. Select age group

20-29 30-39 40-49 50-59 60 and above

2. Gender

Male Female

3. What is your highest level of education?

Associate's degree Bachelor's degree

Master's degree Doctorate Other

4. How long have you used EMR system?

5. How often do you use EMR?

6. How do you feel about using EMR system?

7. Please describe the advantages of the EMR system in the hospital.

8. Please describe the disadvantages of the EMR system in the hospital.

9. Have you faced any problems using EMR system? Please clarify.

10. If any problem occurs, what steps do you take to identify and resolve the problem?

11. What do you expect most from your hospital to improve the existing EMR system?

12. Do you have any other thoughts about your experience with EMR?

Appendix B. INFORMED CONSENT FORM

Facilitators and Barriers to User Adoption of Electronic Health Record Systems

INFORMATION SHEET

Chief Investigator (Supervisor)	Student Investigator (PhD Student)
Amir Hossein Ghapanchi School of ICT +61(7) 5552 8834 a.ghapanchi@griffith.edu.au	Mohammadreza Najaftorkaman School of ICT PhD +61 (4) 1677 3611 m.najaftorkaman@griffith.edu.au

Why is the research being conducted?

The interview which you are being asked to participate in, is a part of a PhD research study that is focused on factors impacting EMR system adoption. The purpose of this study is to gain a better understanding of the barriers and facilitators of EMR.

What you will be asked to do

Your participation in this study will consist of an interview lasting approximately 30 minutes. You will be asked a series of questions about the EMR system. You are not required to answer every single question. You may pass on any question that makes you feel uncomfortable. At any time you may notify the researcher that you would like to stop the interview and your participation in the study. There is no penalty for discontinuing your participation.

The basis by which participants will be selected or screened

The chief investigator has organized a meeting with EMR system managers. We presented our literature review results and asked them to help us to conduct an interview as the next step of the PhD study. Therefore, the EMR system managers introduced you as an interviewee of this research.

The expected benefits of the research

There are no direct benefits to participants in this research. We hope to learn more about facilitators and barriers to the adoption of the EMR system.

Risks to you

We do not anticipate any risks from your participation in this research.

Your confidentiality

All information collected in this study will be kept completely confidential. At no time will your actual identity be revealed. You will be assigned a random numerical code. The key linking the code to your answers will be kept on a password-protected computer, and only the cheif and student investigator will have access to it. The code key and answers will be destroyed after analysing the transcripts (one month after the interview date). The interview data will be used as a part of the PhD study and presents in the future, but it will not include any identifying information about the participants. Transcriptions will be kept 5 years after the end of the year of release of the research findings.

Your participation is voluntary

Your participation is completely voluntary, and you may withdraw from the study at any time without penalty. You may also skip any question during the interview, but continue to participate in the rest of the study.

Questions / further information

If you have questions or concerns about this research, please contact Dr.Amir Ghapanchi, the chief investigator. You may also contact Mohammadreza Najaftorkaman, the student researcher who is conducting the research in his capacity as a Griffith University student and in order to fulfil the requirements of a PhD degree.

The ethical conduct of this research

The information sheet should indicate that Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Human Research*. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on (07) 3735 4375 or research-ethics@griffith.edu.au.

Privacy Statement

The conduct of this research involves the collection, access and/or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at http://www.griffith.edu.au/privacy-plan or consult via telephone (07) 3735 5585.

Facilitators and barriers to the adoption of Electronic Medical Record system by its users
CONSENT FORM

Research Team

Chief Investigator (Supervisor)	**Student Investigator (PhD Student)**
Amir Hossein Ghapanchi School of ICT +61(7) 5552 8834 a.ghapanchi@griffith.edu.au	Mohammadreza Najaftorkaman School of ICT PhD +61 (4) 1677 3611 m.najaftorkaman@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I am at least 18 years old and voluntarily consent to take part in this research study and to have this interview audio recorded.
- I understand that my involvement in this research will include my ideal conception of EMR and my experience in using this system;
- I have had any questions answered to my satisfaction;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on (07) 3735 4375 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in this interview.

Name	
Signature	
Date	

Appendix C. GRIFFITH UNIVERSITY HUMAN RESEARCH ETHICS

GRIFFITH UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE

14-Jan-2014

Dear Mr. Najaftorkaman

I write further to your application for a variation to your approved protocol "NR: Facilitators and barriers to the adoption of Electronic Medical Record by its users" (GU Ref No: ICT/09/13/HREC). This request has been considered by the Office for Research.

The OR resolved to approve the requested variation:

Requested extension of ethical clearance from 31/12/2013 to 31/12/2014

This decision is subject to ratification at the next meeting of the HREC. However, you are authorised to immediately commence the revised project on this basis. I will only contact you again about this matter if the HREC raises any additional questions or comments about this variation.

Regards

Dr Kristie Westerlaken
Policy Officer
Office for Research
Bray Centre, Nathan Campus
Griffith University
ph: +61 (0)7 373 58043
fax: +61 (07) 373 57994
email: k.westerlaken@griffith.edu.au
web:

Cc:
Researchers are reminded that the Griffith University Code for the Responsible Conduct of Research provides guidance to researchers in areas such as conflict of interest, authorship, storage of data, & the training of research students.
You can find further information, resources and a link to the University's Code by visiting http://policies.griffith.edu.au/pdf/Code%20for%20the%20Responsible%20Conduct%20of%20Research.pdf

Appendix D. QUEENSLAND HUMAN RESEARCH ETHICS

Queensland Health

Queensland Government

Office of the Human Research Ethics Committee

24 October 2013

Enquiries to: Tanya Douglass
Phone: 07 5687 3879
Fax:
Our Ref: HREC/13/QGC/113
E-mail GCHEthics@health.qld.gov.au

Mr Mohammadreza Najaftorkaman
Room 2.31, Building G23,
Griffith University, Gold Coast campus
QLD, 4222

Dear MR Najaftorkaman,

HREC Reference number: HREC/13/QGC/113
Project title: Facilitators and barriers to the adoption of EMR by its users

Thank you for submitting the above project for ethical and scientific review. This project was first considered by the Gold Coast Health Service District Human Research Ethics Committee (HREC) held on 21 October 2013.

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007)* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*. Attached is the HREC Composition with specialty and affiliation with the Hospital (Attachment I).

I am pleased to advise that the Human Research Ethics Committee has granted approval of this research project. The documents reviewed and approved include:

Document	*Version*	*Date*
Application	1	
Response to Request for Further Information		21 August 2013
Application	2	21 August 2013
Master Consent Form		21 August 2013

Please note the following conditions of approval:

1. The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:
    a. Unforeseen events that might affect continued ethical acceptability of the project. Serious Adverse Events must be notified to the Committee as soon as possible. In addition the Investigator must provide a summary of the adverse events, in the specified format, including a comment as to suspected causality and whether changes are required to the Patient Information and Consent Form. In the case of Serious Adverse

Events occurring at the local site, a full report is required from the Principal Investigator, including duration of treatment and outcome of event.

2. Amendments to the research project which may affect the ongoing ethical acceptability of a project must be submitted to the HREC for review. Major amendments should be reflected in a revised online NEAF (accompanied by all relevant updated documentation and a cover letter from the principal investigator, providing a brief description of the changes, the rationale for the changes, and their implications for the ongoing conduct of the study). Hard copies of the revised NEAF, the cover letter and all relevant updated documents with tracked changes must also be submitted to the HREC coordinator as per standard HREC SOP. Further advice on submitting amendments is available from
http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

3. Amendments to the research project which only affect the ongoing site acceptability of the project are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the Research Governance Office/r (by-passing the HREC).

4. Proposed amendments to the research project which may affect both the ethical acceptability and site suitability of the project must be submitted firstly the HREC for review and, once HREC approval has been granted, then submitted to the RGO.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the project t(e.g. typographical errors) should be submitted in hard copy to the HREC coordinator. These should include a cover letter from the principal investigator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the project is discontinued at a site before the expected date of completion.

7. The Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

8. The District administration and the Human Research Ethics Committee may inquire into the conduct of any research or purported research, whether approved or not and regardless of the source of funding, being conducted on hospital premises or claiming any association with the Hospital; or which the Committee has approved if conducted outside [name] Hospital Health Service District.

HREC approval is valid for **three (3) years** from the date of this letter.

Should you have any queries about the HREC's consideration of your project please contact Ms Karlyn Chettleburgh via GCHEthics@health.qld.gov.au or (07) 5687 3879. The HREC terms of Reference, Standard Operating Procedures, membership and standard forms are available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a site until separate authorisation from the District CEO or Delegate of that site has been obtained.

A copy of this approval must be submitted to the District Research Governance Officer/Delegated Personnel with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the Gold Coast Hospital and Health Service District.

Once authorisation to conduct the research has been granted, please complete the Commencement Form (Attachment II) and return to the office of the Human Research Ethics Committee.

The HREC wishes you every success in your research.

Yours faithfully

for
Ms Karlyn Chettleburgh
CHAIR
HUMAN RESEARCH ETHICS COMMITTEE
GOLD COAST HOSPITAL AND HEALTH SERVICE DISTRICT