2015

Using diffusion of innovation theory to understand the factors impacting patients' acceptance and use of consumer e-health innovations in primary health care

Xiaojun Zhang
University of Wollongong

School of Computing and Information Technology, Faculty of Engineering &

Information Sciences

Using Diffusion of Innovation Theory to Understand the Factors Impacting Patients' Acceptance and Use of Consumer e-Health Innovations in Primary Health Care

Xiaojun Zhang

Supervisor: Associate Professor. Ping Yu

Co-Supervisor: Dr. Jun Yan

"This thesis is presented as part of the requirements for the award of the Degree of the Doctor of Philosophy University of Wollongong"

October 2015

Dedicated to my parent and family

for their love, endless support and encouragement

CERTIFICATION

I, Xiaojun Zhang, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Information Systems and Technology, University of Wollongong, is entirely my own work unless otherwise referenced or acknowledged. This document has not been submitted for qualifications at any other academic institution.

Xiaojun Zhang
October 2015

ABSTRACT

Healthcare providers in Australia are currently facing a number of challenges, including the increasing size of the aging population, a shortage of healthcare workers, patient demands for increased access to health information and participation in healthcare decision making and rising health care costs. As a response to these challenges, consumer e-Health is emerged as a potential solution to the problems of accessibility, quality and costs of delivering public healthcare services to patients. Although the potential of consumer e-Health is acknowledged in academia, as well as among certain health care professional groups, it still remains unclear if patients are willing and able to accept and use this innovative service. Academia has recognized the importance of research on e-Health adoption. However, to date, the main focus is on measuring health care outcomes from health care providers' point of view, knowledge needs to be developed in regards to the consumer acceptance and its underlining reason. Therefore, the aim of this research is to study the factors influencing patients' acceptance and usage of consume re-Health innovations.

A simple but typical consumer e-health innovation – an e-appointment scheduling service – was developed and implemented in a primary health care clinic in a regional town in Australia. A longitudinal case study was undertaken for 29 months after system implementation. The major factors influencing patients' acceptance and use of the e-appointment service were examined through the theoretical lens of Rogers' innovation diffusion theory. Data were collected from the computer log records of 25,616 patients who visited the medical centre in the entire study period, and from in-depth, semi-structured interviews with 125 patients after system implementation.

The study results show that the overall adoption rate of the e-appointment service increased slowly from 1.5% at 3 months after implementation, to 4% at 29 months, which means only the 'innovators' in the patient population had adopted this new service. The majority of patients did not adopt this innovation.

The factors contributing to the low adoption rate were: (1) insufficient communication about the e-appointment service to the patients, (2) lack of value of the e-appointment service for the majority of patients who could easily make phone call-based appointment, and limitation of the functionality of the e-appointment service, (3) incompatibility of the new service with the patients' preference for oral communication with receptionists, and (4) the limitation of the characteristics of the patients, including their low level of Internet literacy, lack of access to a computer or the Internet at home, and a lack of experience with online health services. All of social factors are closely associated with the low socio-economic status of the study population.

Although the technological advances required for consumer e-Health are available, and patients are generally positive about such developments in health care services, it is not always easy for consumer e-Health to achieve what its name implies. This study suggests that the uptake of consumer e-Health services takes time, since changing consumers' habits of health service utilisation is not an easy task.

The findings of this study suggest that good communication channels are highly important to the success of technological innovations. Patients must be made aware of this new type of service and its benefits through effective and efficient communication channels. It is recommended that decision makers should craft sound strategies and processes to facilitate the adoption of consumer e-Health innovations.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my supervisor and co-supervisors: Associate Professor. Ping Yu and Dr. Jun Yan. Without them, this thesis would not have been possible. I thank them for their patience and encouragement that carried me on through difficult times. Their continuous supervision and mentoring assisted me to advance in my work and explore new territories in my research field step by step.

This research has been supported by the Centre Health Complex (CHC) under a grant from the both CHC and the University of Wollongong. The authors would like to thank Dr. M.K. Rashid, Dr. Niraj Goureia and Violeta Kuzmanovska for giving us both inspiration and insight to achieve our technical implementation of this work. The authors would also like to acknowledge Dr. Madeleine Cincotta and Dr. Diane Walton for their roles as copy editors and language consultants.

This work would also not have been possible without the great technical assistance given by the staff in SISAT, whose presences and kindness have given me a good memory of studying and living in this country. I am also appreciative of the casual teaching jobs provided by the school during my study which have given a valuable experience in addition to financial assistance during my study. I have been extremely fortunate to have the support of very special friends, Chao Sun and his wife, Siyu Qian, Yan Kong, Song Liu and Xing Su, etc., to whom I am truly grateful.

Last but not least, I am also very grateful to my father Xiyuan Zhang, my mother Weike Chang, my sister Xiaoning Zhang, my uncle Edin and aunty Xuling Zhang who have always supporting me through the most difficult times of this work. Without their love and understanding, it is impossible to accomplish this work!

PUBLICATIONS

Xiaojun, Zhang; Yu, Ping and Yan, Jun. "*Developing a Socio-technical Approach Supporting Communication Process Analysis in Healthcare Information System Development*" [online]. In: Hansen, David (Editor); Schaper, Louise (Editor); Rowlands, David (Editor). HIC 2010: Proceedings; 18th Annual Health Informatics Conference: Informing the Business of Healthcare, 24-26 August 2010, Melbourne Convention and Exhibition Centre. Brunswick East, Vic.: Health Informatics Society of Australia, 2010:160. ISBN: 9780980552027

Xiaojun Zhang, Ping Yu, Jun Yan, Hongxiang Hu and Niraj Goureia, "*Patients' perceptions of web self-service applications in primary healthcare*", pp 242-249, 20th Australian National Health Informatics Conference (HIC 2012), 2012 PMID: 22797048

Xiaojun Zhang, Ping Yu, Jun Yan, Hongxiang Hu and Niraj Goureia, "*Developing an Online Patient Appointment Scheduling System Based on Web Services Architecture*", 7th Asia Pacific Association for Medical Informatics Conference (APAMI 2012), 2012

Zhang, Xiaojun, Ping Yu, and Jun Yan. "*Patients' adoption of the e-appointment scheduling service: A case study in primary healthcare*." *Studies in health technology and informatics* 204 (2014): 176-181. PMID: 25087546

Zhang, Xiaojun, Ping Yu, Jun Yan, and Ir Ton A. M. Spil. "*Using Diffusion of Innovation Theory to Understand the Factors Impacting Patient Acceptance and Use of Consumer E-Health Innovations: A Case Study in a Primary Care Clinic*." *BMC Health Services Research* 15, no. 71 (2015). DOI: 10.1186/s12913-015-0726-2

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE. OVERVIEW OF STUDY

The first chapter of this thesis provides the main concepts of consumer e-Health and motivations of the study. It begins with an introduction of the background of the research areas, including current challenges faced by the primary health care sector in Australia and the role of consumer e-Health in transforming the way health services are delivered. This is followed by a discussion of research aims and problems. The delimitations, methods of the study and structure of the thesis are presented in the last section.

1.1 Introduction

1.1.1 Current challenges faced by primary health care in Australia

The primary health care system in Australia is currently undergoing change, the aim of which is to overcome a number of challenges. These include the increasing size of the aging population, a shortage in the healthcare work force, rising healthcare costs, and patient demands for increasing access to health information so as to participate in healthcare decision making [1]. More recently, with the rapid development of interactive consumer health informatics (CHI) and the increasing use of the Internet as a source for health information and services delivery, there is an increasing trend for primary health care providers to provide consumer e-Health services which allow patients electronic access to their medical information, and better manage their healthcare costs [2-4], or to engage consumers in the healthcare decision-making process, etc., [4, 5].

Emerging consumer e-Health has the potential to balance the enormously and consistently growing healthcare demands with the limited resources available [2-4].

It can complement and even substitute parts of traditional healthcare services by using the latest information technologies [2, 6]. The following sections provide a more detailed description of what consumer e-Health comprises and how it can benefit consumers as well as the advantages and challenges posed by implementing consumer e-Health services.

1.1.2 The concept of Consumer e-Health

Consumer e-Health is an emerging healthcare model which includes everything from very basic health information services to the more advanced interactive services [7-9]. It constitutes the applications of information and communication technologies used for medical practice, educational, research and administrative purposes in the health care context [10-12]. Accordingly, the main concept of consumer e-Health can be described as

"*the use of modern computer technology and telecommunications to support consumers in obtaining information, analyzing their unique health care needs and helping them make decisions and interfaces designed to be used by health consumers*" [13].

The rationale for the adoption and use of consumer e-Health solutions is to improve consumers' access to their own health information and increase their awareness of options for healthcare services, their confidence in self-management of disease, as well as to improve their healthcare outcomes without increasing cost or even reduction of cost [2, 14-18]. In comparison with the traditional 'disease-centered' or 'physician-centered' healthcare models, the new model of consumer e-Health places higher emphasis on providing consumers with better access to various healthcare

services and improving their confidence and capacity in managing their own health problems [19, 20].

The main objectives of consumer e-Health include empowering the patients to be more actively engaged in their own health care, increasing commitment to evidence-based medicine, improving quality of care, and supporting the interactions between patients and health professionals in primary, as well as in secondary care [20-22]. From a global perspective, consumer e-Health aims to improve the accessibility as well as the quality of healthcare services to patients [8].

According to Antonia et al (2011), consumer e-Health applications can be broadly categorized into five main groups, namely (1) health related social networks that support peer-to-peer groups, (2) self-management/self-monitoring which enable patients to manage their own illness, (3) clinical decision support systems, (4) the Internet transmission of personal health records (PHR) or clinical reports, and (5) Internet-based health services and technologies [19].

The most common application domains in consumer e-Health include patient scheduling systems (booking, human resource management), patient-oriented information provision, telehealth applications (such as telemonitoring or teleconsultation), electronically supported patient self-management functions, patient electronic medical record, online electronic claims processing or other online services connecting patients with their health service providers [23-25].

Telehealth care addresses direct patient care services such as teleconsultation via video-conferencing, telemonitoring or other types of computer-based decision support applications [25]. With the rapid advances in hand-held technology, many clinicians have begun to use portable devices, such as personal digital assistance (PDA), to collect and access patient information whenever patient-specific decisions

need to be made [26-28]. Ping et al. (2009) developed a PDA-based healthcare data collection software – eSTEPS, to collected public health surveillance data [26]. Their trial results show that, in comparison with a paper-based survey, 62% of the participants perceived that the PDA-based survey took less time to complete the whole data collection process, and the cost was also significantly reduced [26].

More recently, the use of mobile phone and tablet devices to support consumer-centered healthcare services has become a growing field of research and practice. Several previous studies have highlighted the successful use of mobile phones to support healthcare interventions, including data collection for healthcare research [29, 30], telemedicine and remote clinical practice in rural areas [31], off-site medical diagnosing in developing nations [32], and decision support for medical professionals [33, 34]. Franko and Tirrell examined the use of smartphones among medical providers in a training program in the United States [35]. Their study results show that 56% of care providers use smartphones and associated applications in clinical practice [35]. For patients, the use of smartphones offers opportunities to improve their access to healthcare services and self-management of chronic diseases, reduces the cost of healthcare and improves their healthcare outcomes [34, 36-39]. Susannah and Maeve evaluated the use of smartphones for healthcare related purposes by the U.S. adults [39]. Their study results show that 52% of smartphone owners used their devices to access healthcare information, while 19% of them have installed an healthcare application on smartphones to manage their health conditions, such as tracking exercise, monitoring diet, weight, blood pressure or diabetes, etc. [39].

According to Bauer (2002), consumer e-Health services are typically delivered through biomedical Websites and online support groups for health-related purposes

[25]. These services are managed by either private or non-governmental sector organizations, or commercial companies that provide healthcare information and services [25]. Other types of consumer e-Health services include e-prescriptions, clinical test results, online formularies, and doctor-patient communication [40]. Cline and Haynes (2001) summarized three ways for consumers to access health information online: (1) directly searching through the Internet, (2) attending online support groups, and (3) consulting a health professional through online services [41]. Currently, a substantial amount of consumer e-Health initiatives are in either the development or implementation phase [42, 43], such as the Patient-Centered Access to Secure Systems Online (PCASSO) in the United States [42], or "Personally Controlled Electronic Health Record" (PCEHR), which is implemented by the National E-Health Transaction Authority (NETHA) in Australia [43]. According to NEHTA, PCEHR aims to allow a patient's health record, which is usually geographically distributed among different care providers, to be more easily and securely accessible by patients [43]. PCEHR provides patients with the opportunity to access to general health information rapidly, reduce duplication of services, provide greater portability of health records and enhance the quality of information exchange between patients and care providers [43]. In order to increase the uptake of PCEHR in the local community, in 2015, the Australian government allocated a $485 million budget to transform the PCEHR into a new myHealth Record system [44]. This new e-Health platform aims to provide a more user-friendly interaction among patients and with healthcare providers so as to better meet and better meet their specific needs [44].

Future initiatives in consumer e-Health will empower patients to use health information technology to enhance their knowledge of disease processes and

improve their health status. According to the Australia National E-Health strategy, over the next 10 years, the electronic communication of health information will cover 90% of consumers or their care providers, and over 50% of them will be able to actively access and use electronic health records to manage their health and interact with the health system [45].

1.1.2.1 Advantages of consumer e-Health

As explained previously, consumer e-Health has the potential to support patient-focused primary health care services and to provide more consumer-centered and high-quality health care outcomes [2]. The following sections summarise the main benefits of consumer e-Health.

(1). Better patient care and health care quality

As the public use of the Internet grows, health care providers increasingly recognize the potential of using the Internet to provide more consumer-centered health care services to a large portion of the population, to increase the service quality [46-49], and to reduce costs simultaneously [47]. Appleby (2000) summarizes the main applications of the Internet in the health care industry, including patient education, establishing new relationships between care providers and patients, increasing operational efficiency, marketing and administrative transactions [48]. Kerwin (2002) argues that Internet applications, such as consumer e-Health, have the ability to support six facets which are key in improving health care outcomes, including patient safety, effectiveness, patient-centered delivery that reflects patient preferences, timely service delivery, efficient resource usage and equitable delivery of care [46]. Finkelstein et al. (1999) recognize that e-Health has the potential to provide great convenience to patients, since it enables patients to access information

and care from home, rather than travelling to the doctor and standing in line [49]. Therefore, the service quality of primary health care for patients can be further improved as the information exchange and communication flow with patients is facilitated and supported by consumer e-Health applications [47].

(2). Empowering patients and prompting self-management

In the traditional doctor-patient relationship, patients generally get limited face-to-face time to gain information from their doctors [7]. Conversely, consumer e-Health provides patients with a new channel of accessing information from their care providers. It gives more power to patients by enabling them to collect a much wider spectrum of health information through the Internet and become less dependent on health care professionals [25, 50, 51]. This health information, such as alternative approaches to medical treatment, can be used to support patients' self-management, expand their choices, and allow them to take responsibility for their own health [7, 9, 52, 53]. In addition, the shift in power and self-management also challenges the care professionals to offer more new types of care services [52].

(3). Facilitate communication, information exchange and reduce costs

Consumer e-Health is seen as an opportunity to improve communication between health care providers. The types of applications include communicating via email, or other types of online messaging tools, which can fundamentally change the way health care providers communicate, especially in primary health care, as it is steadily becoming an important part of daily practice [54, 55]. In comparison with paper-based communication, consumer e-Health can bring following advantages to GPs:

- Allows the establishment of the rapid, asynchronous, and frequent communication directly with other allied health professionals [25, 56].

- Higher quality of data communication and more complete information about patients' medical history [57, 58].
- Integration of message, e.g. results can be automatically sent to computer based patient management systems, which will lead to reduction of error in data processing, reduction of time consuming in data searching, and avoidance of duplication of medical steps [58, 59].
- Reduced workload and administrative cost [50, 58, 59].

(4). Increasing the accessibility of primary health care services

Nowadays, many clinicians keep patient information in an electronic format and this information can be accessed by downloading into the computers whenever patient-specific decisions need to be made [27]. Consumer e-Health supports electronic communication and information exchange about the medical issues and diagnosis of complicated diseases. Therefore, it has potential to increase access to both health care services and information [7, 41, 60]. One survey found that 50% of the patients expressed an interest in accessing their personal physician's website or e-mailing their physicians, and one-third considered themselves likely to switch to health care providers who accept e-mail communication [7]. Additional consumer e-Health applications include e-appointment scheduling, real-time messaging, and access to medical information for patients [50, 60, 61] [62]. Some of these applications are delivered via online self-service, which is available 24/7, thus making primary health services more convenient for patients [60]. In particular, consumer e-Health provides the opportunity to improve rural access to primary health care services, since the Internet can reach far more greater regions than the traditional health services [62].

1.2 Research Questions and Contribution of the Study

1.2.1 Discussion of the research questions

The ability of consumer e-Health to improve the public health service delivery and empowering patients is acknowledge, while at the same time, it is recognized that consumer e-Health provides the opportunity to change the way in which patients access health care information and make decisions [63, 64].

Although the potential of consumer e-Health has been recognized, there still remain some questions about whether patients are willing and able to accept and use this healthcare innovation. This is because consumer e-Health services are quite different from other consumer services, the engagement of consumer e-Health activities by both care providers and patients is highly dependent on the availability of technology, the patient's demand while under considerable stress, and individual's literacy level with respect to the technology used [64-66]. There are significant concerns with a mismatch between what is supplied and what is demanded, which might hinder patient acceptance and use of e-health services, and lead to a loss of return on investment for healthcare organizations [67, 68]. Many e-Health projects have failed as the services implemented simply did not correspond to what consumers wanted to use [40].

Previous studies suggested a number of factors, such as device usability, socio-demographic variables, and users' computer skills etc., as the determinants to predict an individual's acceptance of, or resistance to, healthcare information technologies [69-77]. A systematic review of studies on patient acceptance of consumer-centered health information technologies (CHIT) reveals that major variables (67 of the 94 variables) associated with consumers' acceptance of CHIT were patient factors [74]. These include socio-demographic factors, education level, prior experience of using

computers, and health- and treatment- related variables [74]. In addition, human-technology interaction, prior experience of using computer/health information technologies and environmental factors appear to be significantly associated with patient acceptance of CHIT [74].

A meta-analysis by Dohan and Tan (2013) of 15 articles recognizes that perceived usefulness is positively associated with a consumer's intention to use web-based tools for health related purposes [75]. Another study on the impact of low literacy on the use of the Internet for searching health information noted that, persons with low literacy levels made more mistakes during web-based searches and exhibited more reluctance to access online health services [73].

Physical limitations for older adults in the use of e-Health services were also identified [76, 77]. Choi reported that in the US, the rate of Internet usage for health related purposes by older adults ranges from 32.2% in 65-74 year olds to 14.5% in the 75-84 year olds [76].

Moreover, the difference between acceptance and continued usage of IT was also studied [63, 78]. Hsu *et al*. (2005) investigated the acceptance and use of e-Health applications, including ordering prescriptions, scheduling appointments and asking medical questions, over a four-year period in the United States [63]. Their study found that most people, even though access is given, still lack of interest in using e-Health services [63]. According to Karahanna et al. (1999), adoption and continued use of an IT innovation represent different behavioral intentions [78]. IT adoption is the initial usage (new behavior) of an IT innovation at the individual level, whereas IT usage is the subsequent continued usage of an IT innovation after adoption at the individual level [78]. Consequently, factors determining user acceptance of an IT innovation differ from those affecting users' attitudes toward continued usage of the

IT innovation [78]. Therefore, it is important to distinguish these two concepts and investigate factors impacting on each of them.

Although many studies relating to patient acceptance of e-Health services have been conducted, to date, no attempt has been made to interpret and synthesize the evidence about factors influencing patient acceptance and use of consumer e-health applications in a primary health care context. In addition, many researchers focused on measuring health outcomes from the care provider's point of view [79, 80], despite the fact that some researchers believe that patients' views on patient-centeredness predict healthcare outcomes [63, 81, 82].

The above challenges motivate this study to address the research questions which can be stated as:

- **What are the factors influencing patients' acceptance of consumer e-Health services?**
- **What are the factors influencing patients' continued or discontinued use of consumer e-Health services?**

1.2.2 Purpose and expected outcomes of the study

As discussed above, the aim of this study is to identify and analysis factors that influence patients' acceptance and use of consumer e-Health services in primary health care. The finding of the research is not just making academic contribution, it also provides some implications to the practice. Through the identification of determinants of patients' attitudes towards acceptance and use of consumer e-Health service, health care providers can develop more complicated e-Health innovation and associated practice, such as myHealth Record system, and to ensure it progressing in the right direction and achieve the expected outcomes. In addition, the knowledge generated from this study is also valuable to the planners and managers of primary

health care systems charged with the responsibility of developing and implementing more complicated consumer e-Health services and technologies.

1.3 The Scope of the Study

As previously explained, consumer e-Health encompasses a broad range of technological applications that exist in various forms that can be used for clinical, educational, research, and administrative purposes [2]. Some definitions associated with consumer e-Health strictly emphasized on Internet applications for process and exchange of health-related data so as to improve the efficiency and effectiveness of health care delivery [7-9]. As this study aimed at investigating factors affecting patients' adoption and use of consumer e-Health in primary health care, it concentrates on the Internet as an e-Health platform, through which patients can directly access various consumer e-Health services offered by healthcare professionals. Therefore, consumer acceptance and use of other types of e-Health innovations are not the scope of this study.

1.4 Research Approaches

1.4.1 The identification of the patient e-appointment system as the consumer e-Health system that needed to be designed, developed and implemented in this study

This PhD project was established with joint sponsorship of a primary health care clinic, the Central Health Complex (abbreviated as CHC herewith), and the University of Wollongong. As there was no consumer e-Health system available at CHC, the management of the clinic believed that a specific type of consumer e-Health system – a patient e-appointment scheduling system, was urgently needed. This is because the management believed that such a system could improve

consumer e-Health appointment making process through relieving the pressure of phone-call based appointment service. Therefore, this PhD project is responsible for the design, development, implementation and evaluation of the e-appointment system. It is expected that through the study of the adoption of this system, we can improve our understanding of patient behaviour in adopting consumer e-Health applications and the factors that influence their acceptance and usage behavior.

1.4.2 The design and development of the e-appointment system

To avoid the failure caused by "hard system thinking", a socio-technical approach to the system requirements identification and implementation was taken in this PhD project. This is followed by the evaluation of the e-appointment system through a case study for 29 months. Therefore, the design and development of the e-appointment system is an integral component of whole study. According to the classification of Antonia et al. (2011), the e-appointment service is a particular type of consumer e-Health application: the use of the Internet for online health services [19]. Chapter 3 provides a detailed description of the socio-technical approach and its application in the study.

Nowadays, healthcare organizations often own a large number of heterogeneous healthcare information systems (HIS) that are fragmented and poorly integrated [83, 84]. The design and implementation of an integrated HIS that supports the retrieve of patient information from different systems used by different care providers has still proven to be a difficult task [85]. The same challenge was found at CHC. As general practitioners and allied health professionals use different patient management systems and operated by different databases installed at CHC. To address this challenge, an integrated patient e-appointment system is designed based on a

mediation architecture. The advantage of this design is to allow the integration of several autonomous, heterogeneous, and distributed HIS in CHC without affecting the local functions of each system. Chapter 4 provides a detailed description of the design and development of the e-appointment system.

1.4.3 Evaluation patients' acceptance and usage of the consumer e-Health system

A case study was undertaken after system implementation to evaluate patients' acceptance and usage of the e-appointment system. To increase the scientific value and generalizability, a theoretical research framework was used as a lens to address the research questions. Empirical data was collected through in-depth, semi-structured interviews with patients, and from extracting log data from the e-appointment system database.

1.5 Structure of the thesis

The thesis consists of six chapters. In this chapter, the concept of consumer e-Health was presented. This led to discussion of the research question and the aim of the study. In the next chapter, relevant theories and models that related to individual acceptance and use of IT innovations are reviewed. It forms the theoretical foundation of this study. This is followed by Chapter 3 which describes the development of the research model and the methodological approach that was taken to meet the goals of the study. In Chapter 4, a detailed description of the development of a specific consumer e-Health system is presented. In Chapter 5, the results of the qualitative and quantitative data analysis are presented and discussed. In the final chapter, the conclusions of the study are drawn, along with the implications of the study for both theory and practice (see Figure 1.1).

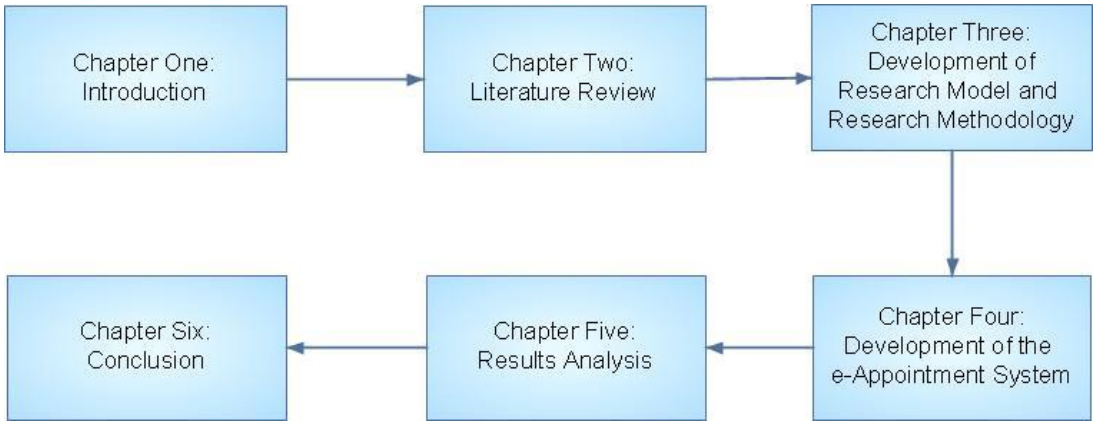

Figure 1.1 Structure of the thesis

CHAPTER TWO. LITERATURE REVIEW

This chapter reviews the primary health care system in Australia and its challenges. It also examines the existing research on acceptance of information technology and theoretical approaches that are helpful for the conceptualization and conduct of the present study. It seeks to situate the studies of user acceptance of information technology in a broader scholarly literature, and to place the present study within the context of primary health care practice so as to gain understanding of the relevant theories and methodologies that have been used by previous scholars to approach topics similar to this study. This is also helpful in positing the study in the development of user acceptance of consumer e-Health in primary health care.

The first section provides a brief overview of primary health care in Australia. This is followed by the review of several contemporary theories about user acceptance and use of new technologies and their applications in the healthcare context, with the lens gradually moving to adoption of consumer e-Health by patients. This chapter closes with summary remarks.

2.1 The Primary Health Care System in Australia

2.1.1 The status and components of primary health care in Australia

In Australia, the comprehensive primary health care services involved four main types of services and providers: general practice, community-based health services, private allied health providers, and aboriginal community controlled health services [86]. General practice is the first point of contact in the Australia health system. Patients are usually required to see a general practitioner (GP) in order to be referred

to other specialists, such as physiotherapists, dieticians, podiatrists and optometrists [87].

General practice is generally organized on a small business or sole practitioner model which consists of both biomedical and social services [88, 89]. General practitioners usually see themselves as independent professionals who choose when and where to practice, which patients to accept and what fees to charge [87]. They are aware of psychological and social contributions to illness and disease, and therefore focus on how to apply bio-psychosocial-semiotic approaches to the patient diagnosis and management [87]. Patients can choose their own GP and are reimbursed for all or part of the GP's fee by Medicare, depending on the GP's billing arrangements [87]. In addition to GPs, practice nurses have become more common over the past ten years in Australian general practice [90]. According to the Australian Medicare Local Alliance, there are now more than 63% of general practices that have employed one or more practice nurses, with one full-time equivalent (FTE) practice nurse to every 1.78 GPs [90].

Community-based health services are the second largest part of primary health care. These services, which can be directly accessed by patients, provide a wide range of care and treatment from generalist community nursing, allied health to more specialized areas, such as early childhood, alcohol and other drugs, mental health and sexual health [91]. In comparison with general practice, community-based health services takes a broader approach with a stronger focus on population health and health promotion in primary health care [91]. In recent years, there has been an increasing emphasis on hospital avoidance, post-acute care and chronic disease management in community-based services [92].

Private allied health services include dentists, physiotherapists, chiropractors, dieticians, podiatrists, optometrists and pharmacists [87]. In contrast to GPs, private allied health professionals are specialized in a particular body system, disease or group of diseases [87]. Patients are generally referred to the allied health professionals who act as part of the general practice team or as independent co-located practitioners [87]. Hence, maintaining a good inter-professional cooperation between GPs and allied health professionals is essential in providing high-quality primary health care to patients, especially when confronted with chronic and complex disease management [87].

Currently, there are over 140 Aboriginal Community Controlled Health Services (ACCHS) operating across Australia in all States and Territories [93]. These services are delivered by multidisciplinary team workers including general practitioners, allied health workers and Aboriginal health workers [93]. Overall, more money is invested in primary health services for indigenous Australians per person than non-indigenous Australians [93]. However, Aboriginal people still suffer a higher burden of ill health, such as a higher prevalence of coronary heart disease and diabetes, and die at a younger age than non-indigenous Australians [93]. Factors affecting the ongoing poor health conditions of indigenous Australians are various, including difficulty in accessing health care facilities, distance from urban centres and poor socioeconomic conditions [93].

2.1.2 Communication and information sharing in primary health care

In Australia's primary health care context, a GP is normally regarded as an 'information manager' who controls the flow of a patient's information [54]. Therefore, the quality of primary health care depends largely on the quality and

frequency of communication between the health care providers and patients involved [54, 94-96]. Bates et al., (2003) illustrates the flow of information exchange among health care providers in primary health care, as shown in Figure 2.1.

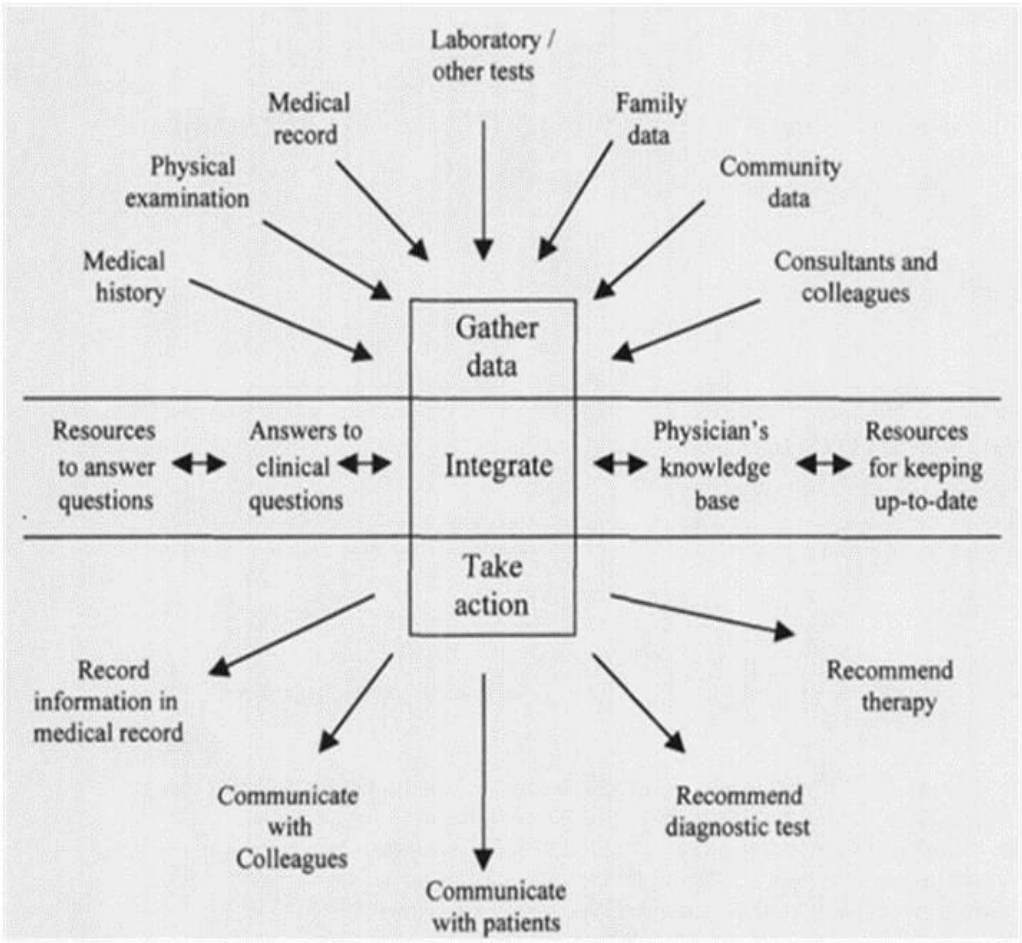

Figure 2.1 Flow of information exchange in primary health care [95]

It can be seen that patient's health care information is gathered from a wide variety of sources, including medical records, consultants, community data and family data [95]. The information is integrated with the physician's knowledge base and other sources of medical information, to reach a whole-person integrated 'whole-care knowledge' [95]. Afterwards, the integrated information is communicated to patients or other health care providers [95]. This model affirms that GPs should be placed at

the centre of integrated care practice to ensure close collaboration with patients and other allied health clinicians [54].

A more detailed analysis of information sharing and communication between patients and health care providers has been conducted by Weiner et al. (2005). They proposed a framework to outline the information exchange between care providers and patients [54]. (See Figure 2.2)

According to this framework, communication and information exchange in primary health care proceed in two dimensions: one is between health care providers and patients, through which the patients' health care information is obtained [54]; the other is between GPs and other care providers, such as allied health clinicians, which is essential for integrated primary health care services [54]. Their study results show that information technologies can be employed in both dimensions to support asynchronous communication and information sharing in integrated primary health care practice [54].

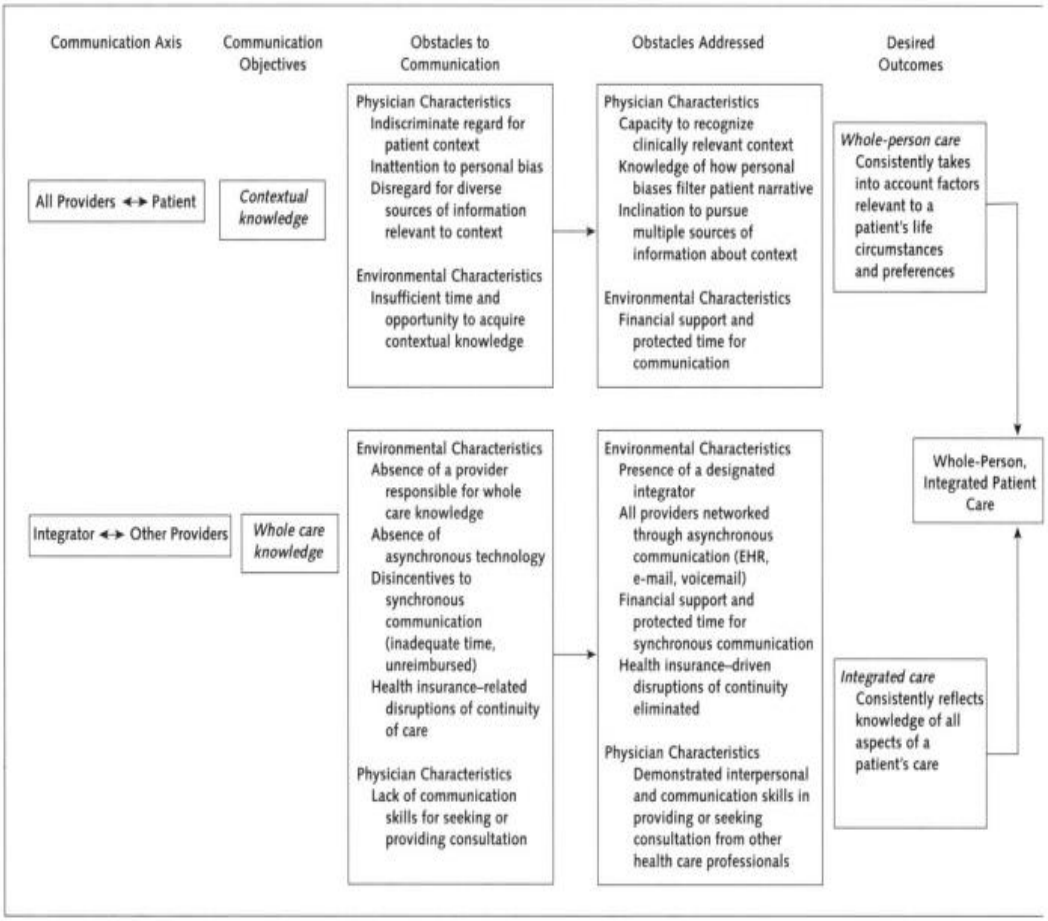

Figure 2.2 The proposed framework for effective information exchange in Primary health care [54]

2.1.3 Patient-Centered primary health care

More recently, the concept of 'patient-centeredness' in primary health care has been recognized as a growing area of importance as it can greatly improve patients' access to their health information and allow them to better manage their health costs [14, 97-99]. Davis et al., (2005) illustrated seven principles of patient-centered primary health care practice:

- **Superb access to care**: Patients can easily make appointments with preferred date and time through e-mail or telephone. Waiting time is minimized.
- **Patient engagement in care**: Patients can access their medical information provided by practitioners.

- **Clinical information systems that support high-quality care, practice-based learning and quality improvement**: practitioners can easily access lab and test results and information on decision support and recommended treatment.
- **Care coordination**: practitioners and specialists care is coordinated with multiple physicians through the system to prevent the occurrence of errors.
- **Integration, comprehensive team care and smooth information transfer across fixed or virtual team of providers**: A free and open communication flow exists amongst physicians, nurses and other professionals to avoid redundant clinical information.
- **Ongoing, routine patient feedback to doctors**: Electronic form of patient survey is provided to practitioners through the Internet or other advanced network technologies.
- **Publicly available information**: Patients can access standardized information on physicians accurately, to enable them to choose the best practice that meets their health care needs.

In the 21st century, the emergence of the Internet enables health care providers to deliver more patient-centered primary health care services faster and more efficiently [7, 10, 46, 52, 100]. As Duffy et al., (2003) indicated, the Internet provides an opportunity to deliver health care on both a global as well as a local level. The Internet serves as a tool to improve access to health care services to geographically distributed patients, support information exchange, reduce cost and improve the quality of care to patients [46, 52]. More recently, there is a trend for healthcare providers to provide consumer e-health services to patients in order to improve

health care decision making, enhance health management, and produce better patient outcomes [6, 7, 13, 100] [11]. This is because consumer e-Health has potential to support the patient-centered primary health care by shifting health care more towards patients to provide a more consumer-centered and high quality health care service [13].

A more detailed explanation of what consumer e-Health comprises and how it can benefit consumers was provided in Chapter 1. The following section provides an overview of different existing theoretical frameworks which are used in the Information Systems (IS) domain to assess the acceptance and use of new IT products by individuals.

2.2 General Theoretical Approaches to Study User Adoption of IT

2.2.1 An overview of contemporary approaches

Information technology acceptance is a process which is influenced by complex external and internal factors [101, 102]. Several competing theoretical models have been proposed and used to investigate the determinants of acceptance and use of new information technology [101]. One of the most important streams, led by Davis, and Venkatesh et al, focuses on the determinants of individual acceptance of new information technologies by using behavioral intention (intention to adopt a new technology) or behavior itself (actual adoption of a new technology) as dependent variables [103, 104]. The underlying hypothesis of this stream is the assumption that an individual's adoption behaviour (adoption of a new IT system) is determined by the individual's intention to perform this behaviour (intention to use this new IT system). The representative intention-based models include Davis' technology acceptance model (TAM) [103], and unified theory of acceptance and use of

technology (UTAUT) [101]. TAM is developed based on the theory of reasoned action (TRA) [105]. TAM is particularly attractive because of its consistently good predictive record in a variety of contexts, including healthcare settings [106-109].

Another important stream has considered the success of adoption of new IT systems at the individual or organizational level and task-technology fit [110, 111]. This line also uses behavioral intention or behavior itself as the dependent variables but the determinants are usually established according to the characteristics of the new technology. The major models include DeLone and McLean's information success model (D& M) [110], and Rogers' innovation diffusion theory (IDT) [111].

The following sections outline the main features of the theoretical models which are most frequently used in studies of technology adoption, and more specifically in studies in the healthcare context.

2.2.2 The foundation of user adoption behavior research – Theory of Reasoned Action

The theory of reasoned action (TRA), developed by Fishbein and Ajzen (1975) [105], is one of the most influential theories used to explain human behavior in a wide range of contexts [101]. It is based on the assumption that an individual's actual behavior is determined by their intention to perform this behavior, as shown in Figure 2.3. Therefore, the construct of intention is recognized as a strong mediator of any effects on actual behavior [112].

The TRA suggests that individuals will perform a particular behavior when they have a positive attitude towards performing this behavior and when they believe that others important to them think they should perform it [105]. According to TRA, behavioral intention (BI) can be explained by the attitude towards behavior (A) and subjective norm (SN) [105]. The attitude towards behavior is defined as "an

individual's positive or negative feelings (evaluative effect) about performing the target behavior " [105]. It reflects personal influences and how the individual evaluates performing this behavior [105]. The attitude towards behavior is determined by the individual's perceptions about the consequence of performing the behavior and the perceived value of this consequence [105]. Subjective norm refers to " the perception that most people who really matter to the individual think that he either should or should not perform the behavior in question" [105]. It captures the social impact, reflecting "the person's perception of the social pressures put on him to perform or not perform the behavior" [105].

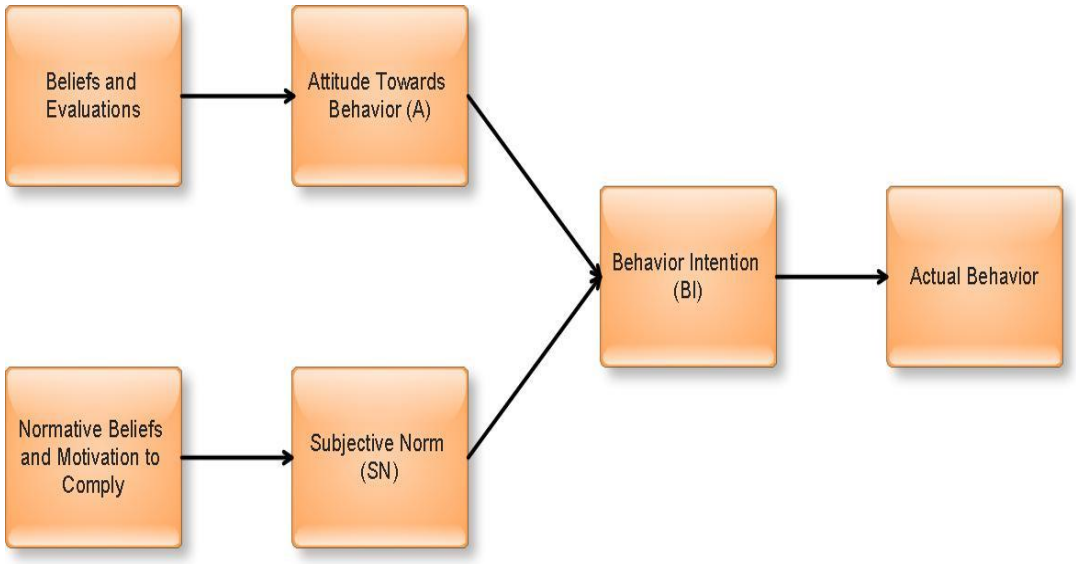

Figure 2.3 The Theory of Reasoned Action

2.2.3 Models for study user adoption of new technology – TAM and its extensions

2.2.3.1 The concept of TAM

The Technology Acceptance Model (TAM), proposed by Davis (1989), was derived from TRA. It was used to predict the acceptance and use of a specific information

technology within organizations [112] [103]. To date, it has become one of the most cited and influential models among IT acceptance literature [101, 108, 113].

Relying on TRA, behavior intention (BI) is assumed to be the main determinant of the actual behavior. Based on this assumption, TAM further hypothesizes that an individual's intention to use a particular IT system is determined by the person's attitude towards using the system [103, 112]. However, one of the main differences between TRA and TAM is that TAM does not include the social influence component – the construct of subjective norm. In TAM, attitude towards using the system can be further explained both by perceived ease of use (PEOU) and perceived usefulness (PU), as outlined in Figure 2.4.

Perceived ease of use was defined by Davis (1989) as "the degree to which individuals believe that using a particular system would require no effort" [103, 112], whereas perceived usefulness relates to "the degree to which individuals believe that using a particular system would enhance their job performance" [103, 112]. Perceived usefulness is hypothesized to influence behavioral intention directly. This is because individuals might intend to use the system when they believe it is useful and they are able to do their job better, but the individual does not necessarily form a positive attitude towards actual use of the system [103, 112]. According to Davis (1989), PEOU influences the attitude and behavior through two main mechanisms, namely self-efficacy and instrumentality [103, 112]. Self-efficacy is reflected in the hypothesized impact of PEOU on attitude, and instrumentality is reflected in the hypothesized impact of PU on behavior [103, 112]. Although both PU and PEOU are found to be the significant determinants of intention to use, PU has emerged as a stronger determinant than PEOU [114]. Davis (1989) suggests that PU can be used as the major determinant, whereas PEOU is the secondary indirect determinant of the

prediction of an individual's usage of new system [103, 112]. Other determinants, such as demographics, personal traits and technology attributes, were suggested to be included in a group of external variables which affect attitudes only through mediating the role of PU and PEOU [112] (see Figure 2.4). By hypothesis, the greater the perceived usefulness and the perceived ease of use, the better an individual's reactions towards the system and the stronger their intention to adopt it [103, 112].

Extensive testing of TAM has proven that it is a well-established and powerful model for explaining and predicting an individual's acceptance of technology [102, 115]. Davis et al. used both TRA and TAM to examine individual acceptance of technology over two periods of time [115]. Their study found that TAM explained up to 50% of the variance in individual's behavioral intention to use the technology, whereas TRA explained around 32% [115]. In addition, Davis et al. (1989) argue that the construct of behavioral intention should be regarded as the major determinant in both TRA and TAM, as it can mediate all external effects on users' usage behavior [115]. This is supported by Venkatesh and Davis (2000), who found behavioral intention to be a significant mediator of all other effects on usage; the correlation of behavioral intention and actual use in all tests was found to be between 0.44 and 0.57 [102]. Another major finding of the study by Davis et al. (1989) is the difference in the results depending on the period of time when the individual's perception of the technology use was measured [115].

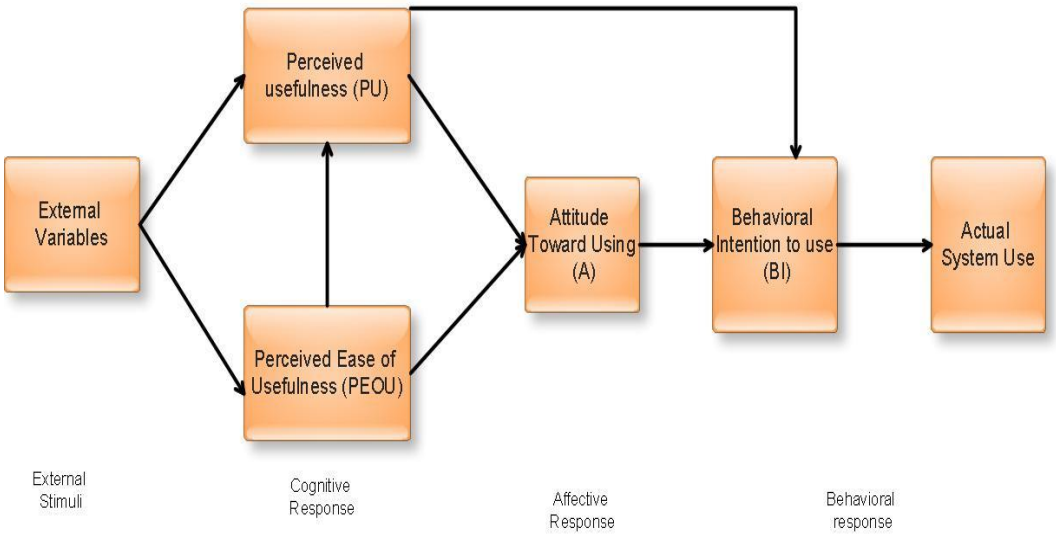

Figure 2.4 Technology Acceptance Model

2.2.3.2 Applying TAM in health care context

Within the healthcare context, TAM has been widely used as a research model to explore why and how healthcare providers or organizations adopt new technologies [40, 116-118] [26, 65, 107, 109, 119-125]. Wilson et al. (2004) used TAM, a motivation model and an integrated information technology acceptance model to examine five antecedents of e-health acceptance, namely individual's satisfaction with medical care, healthcare knowledge, Internet dependence, information seeking preference, and healthcare needs [40]. Their results demonstrate that all tested IT acceptance models and five antecedents performed well in predicting and explaining patient acceptance of e-health [40]. Lanseng et al. (2007) used TAM to investigate consumer readiness and attitude towards acceptance of self-service technology in health-diagnosis [65]. Findings show that TAM is a scientifically sufficient model to predict individual's future behavioral intention of using self-service IT applications [65]. Another recent study into e-health acceptance was conducted by Klein, who

used TAM as a conceptual framework to examine patient's Internet usage for health-related purposes [116]. Their study results show that TAM explains between 47% and 74% of the variance in patient's behavioral intention to use Internet-based health services [116].

2.2.3.3 Extensions of TAM

Although TAM is a well-established and powerful model and has been refined over the last several years, it has been criticized for its low explanatory power [123, 126]. Researchers constantly seek to improve its capability to explain and predict technology adoption by individuals [79]. Venkatesh and Davis (2000) extend TAM by incorporating antecedents to PU, including social influence process variables (subjective norm, voluntariness, and image), as well as cognitive instrumental process variables (job relevance, output quality, result demonstrability, and experience) [102]. The resulting model is known as TAM2, and its constructs and their relationships are shown in Figure 2.5.

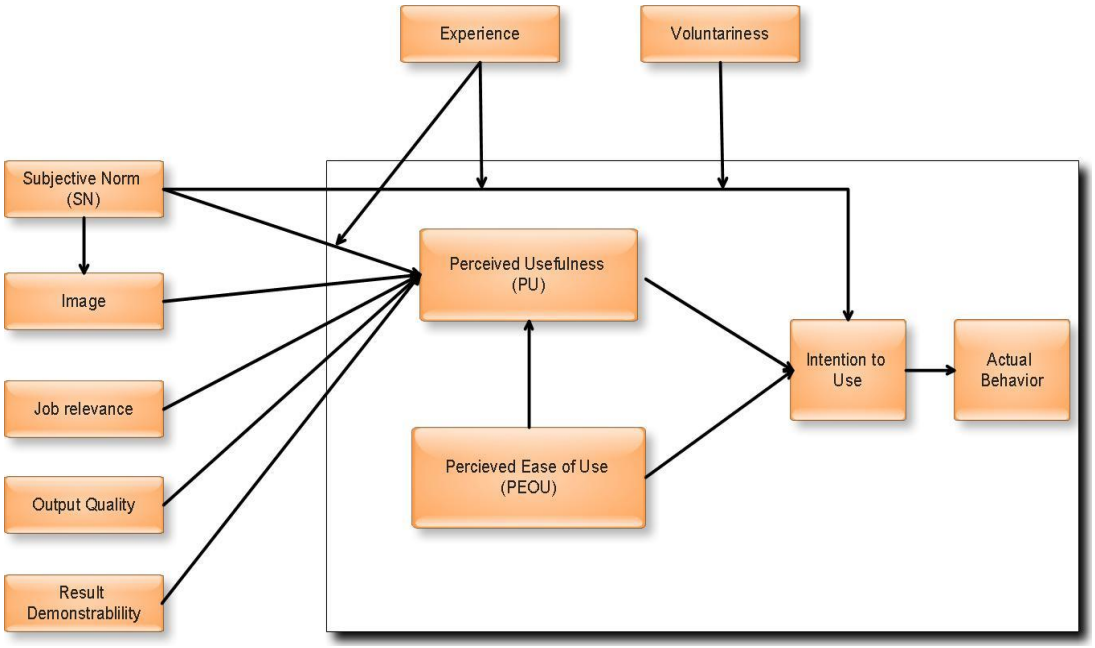

Figure 2.5 TAM2 – Extension of technology acceptance model [102]

TAM2 was tested and adopted in various contexts. Venkatesh and Davis (2000) tested TAM2 in a longitudinal study on four different computer systems in four organizations [102]. Their findings suggest that TAMS2 was strongly supported with 34% to 52% of the variance in usage intentions being explained, and up to 60% of the variance in perceived usefulness perception [102]. In healthcare sector, Yu et al. (2009) tested the applicability of TAM2 to the acceptance of health IT by care providers [109]. Their study results show that TAM2 can explain 34% of the variance in usage intention [109].

Later, Venkatesh et al. (2003) derived a Unified Theory of Acceptance and Use of Technology (UTAUT) by integrating eight prominent technology acceptance models [101]. UTAUT hypothesized four core determinants of behavioral intention and usage, including performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) [101]. The relationship between these determinants and dependent variables are moderated by age, gender, experience and voluntariness [101], as shown in Figure 2.6.

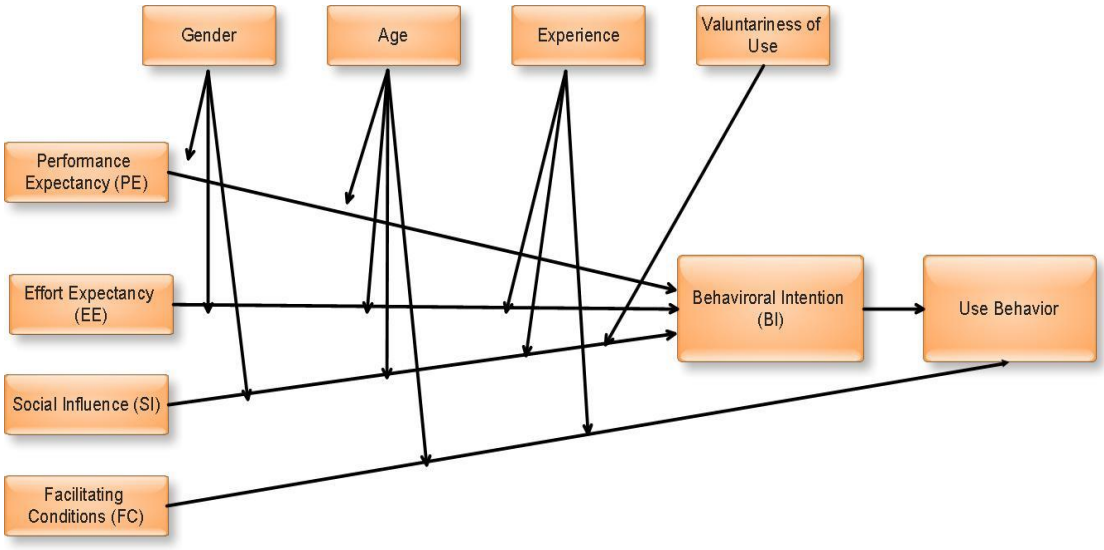

Figure 2.6 Unified theory of acceptance and use of technology [101]

Since it was firstly proposed in 2003, UTAUT has been increasingly applied in technology acceptance and usage studies [127-131]. Duyck et al. (2008) used UTAUT to investigate factors influence the adoption of Picture Archiving and Communication System (PACS) by hospital physicians [128]. Their findings claim that UTAUT was supported with 31% to 37% of the variance in behavioral intention being explained [128]. Lin and Anol (2008) extended UTAUT to examine the adoption of online social service on the individual level and mass use context [130]. Their study results show that performance expectancy and effort expectancy had a strong direct effect on intention to use the online self-service, whereas the path between facilitating conditions and intention to use was insignificant [130].

Research has shown that the influence of some factors on intention to use IS varies at different stages in the IS adoption process [132]. However, TAM has rarely been used to examine the complexity and dynamics of the adoption process in a healthcare context, such as continuous use of innovation over a certain period of time [108, 133, 134]. This is because TAM tends to view innovation in a static single point of time

frame rather than as a dynamic, longitudinal process [135]. This limitation makes it less desirable for use in the longitudinal innovation acceptance studies. Some empirical studies suggest that TAM can be integrated with other acceptance concepts to improve its predictive power [123, 126]. Conversely, Rogers' innovation diffusion theory provides a theoretical conceptual framework to model the dynamic adoption process by recognizing that adoption of innovation is a gradual process over a period of time. The next section provides a brief review of Rogers' diffusion theory.

2.2.4 Theoretical framework to examine the dynamic adoption process of an innovation – Rogers' Innovation Diffusion Theory

2.2.4.1 The concept of Rogers' Innovation Diffusion Theory

Rogers' Innovation Diffusion Theory (IDT) is one of the most popular theories for studying adoption of information technologies (IT) and understanding how IT innovations spread within and between communities [132]. According to the theory, innovation is perceived as an idea, process, or a technology that is new or unfamiliar to individuals within a particular area or social context [132]. Diffusion is the process by which the information about the innovation flows from one person to another over time within the social system [132].

The innovation diffusion theory has been used since the 1960s to explain the process of innovation adoption. Following an extensive review of the literature, Rogers (1995) found five user-perceived attributes that consistently proved to be determinants of success of an IT innovation: relative advantage, compatibility, complexity, trialability and observability. Relative advantage is the degree to which the user perceives benefits or improvements on the existing technology by adopting an innovation. Compatibility captures the extent to which an innovation is consistent with the existing technical and social environment. The more an innovation can

integrate or coexist with existing values, past experience and the needs of potential adopters, the greater its prospects for diffusion and adoption [136, 137]. Complexity measures the degree to which an innovation is perceived to be difficult to understand, implement or use. An innovation that is less complex is more likely to be accepted by end users [136, 137]. Trialability is the ability of an innovation to be put on trial without total commitment and with minimal investment. It indicates whether potential adopters have opportunity to experiment with the innovation prior to committing to use it. An innovation with higher trialability is more likely to be adopted by individuals [136, 137]. Finally, observability is the extent to which the benefits of an innovation are visible to potential adopters. Only when the results are perceived as beneficial, will an innovation be adopted [136, 137].

In addition to the above five determinants of innovation success, Rogers (1995) argues that there are three elements critical to the diffusion of innovation, namely communication channels, time and the social system. Communication channels refer to the medium through which people get the information about the innovation and perceive its usefulness. It involves both mass media and interpersonal communication. Rogers suggests that mass media has direct, immediate, and the most powerful effect on diffusion because it can spread the knowledge about the innovation to large numbers of potential adopters rapidly, but face-to-face communication among individuals of the same socio-economic status and education level is more effective in persuading potential adopters to accept an innovation [132]. Rogers (1995) has also characterized the individuals of a social system into five groups based on their attitudes toward an innovation: innovators, earlier adopters, earlier majority, late majority and laggards. Innovators, representing 2.5% of the population in a social system, are the first group to adopt an innovation. According to

Rogers (1995), innovators have the ability to understand and apply complex technical knowledge essential for bringing in the innovation from outside of social system. The next group is the early adopters who are a more integrated part of the social system than the innovators. They tend to be well informed about the innovation, well connected with the new technologies and more economically successful. The first two groups of adopters comprise 16% of the population in a social system. The next two groups, which account for 68% of the population of the social system, are early and late majority adopters. The last 16% of the individuals in the social system are laggards. They are the strongest resisters to an innovation and most likely to become non-adopters because of their limited resources and lack of awareness or knowledge of the innovation [132].

The last element, the social system, is defined as "a set of interrelated units engaged in joint problem solving to accomplish a common goal" [132]. The social system constitutes a boundary within which the diffusion of innovation takes place. Rogers (1995) suggests that the structure of a social system affects the individuals' attitude toward the innovation, and it is the main criterion for characterizing the types of adopters [132].

In comparison with other technology adoption theories, such as TAM, diffusion of innovation theory is more comprehensive in providing an in-depth conceptual framework about the influences of socio-technical factors on adoption. In particular, it covers the communication channels, the attributes of the innovation, the characteristics of adopters and the social system, which are assumed to be important factors for individuals' adoption of health care innovations. Therefore, Rogers' innovation diffusion theory was selected as the theoretical conceptual framework for this research.

2.2.4.2 Development of the measurement instrument for studies applying Roger's theory

Many studies have used Rogers' theory as their theoretical framework to explain and predict the adoption of IT innovations in various areas [136-141]. Using systematic review and meta-analysis research methods, Tornatzky et al. (1982) examined the relationship between the characteristics of the innovation and its adoption [136]. Their study shows that relative advantages, complexity and compatibility have significant influence on the acceptance of innovations. Specifically, relative advantages and compatibility facilitate whereas complexity hinders the adoption of the innovation [136].

With the purpose of developing an instrument to measure the initial adoption and possible diffusion of information technology innovations within organizations, Moore and Benbasat (1991) built on the five basic characteristics originally proposed by Rogers (1995) by adding two other constructs. The first, image, refers to "the degree to which use of an innovation is perceived to improve image or status in a given social system" [137]. According to the authors, the reasoning for including this construct is that, although Rogers (1983) sees image as one of the aspects in relative advantage, Tornatzky and Klein (1982) suggested that image must be considered separately from relative advantage owing to the importance of its effect in previous studies [136]. Therefore, by hypothesis, the more clearly individuals realize that adopting an innovation will improve their status within their group, the stronger their intention to adopt it [137]. The second construct added to the instrument was voluntariness of use, defined as "the degree to which use of an innovation is perceived as being voluntary or an act of free will" [137]. The reason for including this construct is that, when considering an innovation, whether an individual is free

to either adopt or reject it must be taken into consideration [137]. By hypothesis, the greater their freedom to adopt it, the greater the possibility that the new technology will be adopted [137].

In addition to the above two constructs, Moore and Benbasat (1991) broke down the observability construct into two constructs "result demonstrability and visibility" [137]. The first, result demonstrability, refers particularly to the extent to which an innovation can be observed before it is adopted [137]. The second, visibility, focuses on the extent to which the benefits of an innovation are visible to the prospective adopters [137].

The instrument developed by Moore and Benbasat tries to capture not only the primary characteristics of an innovation, but also how these characteristics are perceived. Their study shows that the most important characteristics that influence the adoption of IT are voluntariness of use, image, relative advantage, compatibility, ease of use, trialability, result demonstrability and visibility [137].

2.2.4.3 The applications of Roger's theory in health care context

In recent years, diffusion of innovation theory has been used to study individual adoption of new healthcare information technologies [141-147]. Helitzer et al. (2003) applied the diffusion of innovation theory to assess and predict the adoption of a telehealth program in rural areas of New Mexico. Their study demonstrates that Rogers' innovation theory is a suitable tool to understand technology adoption in the context of e-health projects [141]. Chew et al. (2004) used IDT to study use of Internet healthcare services by family physicians. They found that trialability has been a strong motivational factor in the use by family physicians of Internet services [142].

Lee's (2004) qualitative study used Rogers' theory to investigate the adoption of a computerized nursing care plan (CNCP) by nurses in Taiwan. Her study results confirmed that nurses' attitudes toward the adoption of the CNCP was influenced by an easy-to-read format and saving of paper, which is seen as a high level of relative advantage, compliant with the existing nursing practice behavior represents a high level of compatibility, and user-friendly interface design leads a low level of complexity [143]. In addition, findings also show that lack of awareness of the outcomes of the system, lack of appropriate nursing care evaluation and difficulty in retrieving information for later use, are seen as a low level of trialability and observability, decreased nurses' acceptance of the CNCP [143].

Using both qualitative and quantitative research methods, Greenhalgh et al. (2008) examined the diffusion factors proposed by Rogers (1995) and other variables which influencing the adoption of a summary care record (SCR) service by clinicians and patients [147]. The factors examined in her study include attributes of the innovation, the expectations of potential adopters, communication channels, organizational readiness, the implementation process and the socio-political environment [147]. One of the major findings of the study was that users' past experience with information technology must be considered for successful introduction of SCR services [147]. In addition, the extent to which the new service is compatible with the existing habits, personal communication channels and attributes of the innovation also influence the adoption of the SCR service by clinicians and patients [147].

2.2.5 Other adoption studies in the consumer-centered health care context

The successful implementation of consumer e-health depends on wide consumer adoption in order to justify the investment cost [67, 68]. However, much of the

healthcare information system (HIS) research focuses on care providers in an organization when investigating individual adoption of HIS systems [80, 106]. It still remains unclear if patients will be willing to adopt and use e-Health systems in a consumer context [68]. In addition, technology acceptance models are developed in the context of employees rather than online consumer behavior [148]. Thus, to fill this knowledge gap, the current study focuses on investigating the factors influencing consumer adoption of online health care services. The next few sections provide a brief summary of the factors that are considered to be most relevant to the adoption of online services in the consumer context.

2.2.5.1 Preference for personal contact

A common construct included in the research models for online service adoption is the preference for personal contact [149-152]. Curran and Meuter (2005) brought this construct into their research in order to model the uptake of online services by consumers. Their research concluded that the individual's need for interaction had the strongest influence on online service adoption [149]. This fact confirms the view of Dabholkar and Bagozzi (2002) that personal traits are the basis for forming consumer attitudes and behavioural intention. In addition, Lee et al (2010) proved that age is positively correlated with the construct of preference for personal contact, e.g. older people required more personal contact [150]. Reinders et al. (2008) proved that consumers develop negative attitudes towards online service providers if there are not enough options to meet their requirements [153]. Another study conducted by Walker and Johnson (2006) showed that the majority of respondents preferred personal contact when they had a specific issue [152].

2.2.5.2 Technology Readiness

Previous studies show that technology readiness (TR) is a critical factor as it is directly related to the perception of the online service quality [154]. According to Parasuraman (2000), technology readiness is defined as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" [155]. In later study, Zeithaml et al. (2002) points to the need to investigate the consequences of TR in a research model where TR is the core construct [154]. This proposition is supported by the empirical study conducted by Lin et al. (2007) who tested how TR influenced behavioral intentions in the TAM. Their study show that an individual's personal technology readiness affects all constructs in the TAM [156]. Connected to this notion is the inclusion of other factors, such as web skills, efficiency of service, perceived benefits, preference for personal contact and convenience, which have been found to affect usage intentions through the perception of service quality [157].

2.2.5.3 Perceived Risks

Apart from preference for personal contact, Curran and Meuter (2005) include another variable, namely consumers' perceptions of risk, in their study [149]. Risk is a situational variable and addresses the likelihood of a particular outcome given a behavior, and the threat and severity of negative consequences from performing this behavior [149].

Forsythe and Shi (2003) studied the perceived risk and risk reduction in Internet shopping [158]. Their study shows that privacy risk appear to be the major risk factor for Internet shopping [158]. This finding was supported by Kim et al. (2009), who

found that security risk is the most important risk factors for the variable of risk [159].

According to Cunningham et al. (2005), risk perceptions in the online context mainly apply to two forms of uncertainty: behavioral uncertainty (related to the provider and service/product) and environmental uncertainty (related to the technology, the Internet and the infrastructure) [160]. Behavioral uncertainty is correlated with economic, personal, and service provider performance [160], whereas environmental uncertainty is connected with economic and privacy risks [160]. The most common risk variables derived from the literature to date, include security, financial, psychological, physical, social, and privacy [158, 159, 161].

In recent studies, the construct of risk has been researched in different research contexts and empirical evidence offers support for the influential role of the risk construct on consumer adoption of online services [149, 158, 159]. Curran and Meuter (2005) investigated risk within a very specific research context and found risk to be the most significant construct influencing consumer behaviour in adopting online services [149].

2.2.5.4 Demographic Variables

Studies emphasizing on the demographic variables which facilitate or inhibit online service adoption by consumers have also been conducted [150, 151, 162-164]. Wu's (2003) qualitative study shows that male consumers in the age group of 36 to 40 years exhibit a more positive attitude towards online services [164]. Nilsson (2007) conducted a comparative research to examine consumer adoption and usage of online banking services [163]. Their findings show that younger male consumers with

higher educational levels and higher income are more likely to adopt online banking service than older, less affluent consumers [163].

The relationship between personality traits (e.g. technology anxiety and technology innovativeness) and demographics (e.g. age, gender, education and income) and their effects on behavioral intention has also been examined [150, 165]. Lee et al. (2010) proved that consumer demographics influenced online service usage intentions through the mediating effect of personality traits [150]. For example, their findings show that consumers with higher income were less anxious about the technology; males exhibited less technology anxiety than females and older consumers showed more technology anxiety and less technology innovativeness [150].

2.3 Summary of the Chapter

This literature review chapter reviews the relevant studies on individual acceptance and use of new IT innovations, with particular focus on the health care context. It examines several theoretical approaches that have influenced the conceptual work of the present study. It begins with an introduction of the current primary health care system in Australia. This is followed by a review of the main existing models on user acceptance of technology, starting with the Theory of Reasoned Action. Also alternative models to the individual acceptance of IT products were presented, including TAM, TAM2, UTAUT and Rogers' Innovation Diffusion Theory. Previous research that applies TAM and Innovation Diffusion Theory in the health care context were also reviewed. In addition, some external variables relevant to technology adoption in the consumer-centered context were identified. These include preference for personal contact, technology readiness, perceived risks and demographic variables.

Overall, previous studies relating to individual's acceptance of health IT applications are limited to project descriptions and exploratory reports, no attempt has been made to interpret and synthesize the evidence about factors influencing patient acceptance and use of consumer e-health applications in primary health care context. To bridge this knowledge gap, there is an urgent need for research into methods and conceptual frameworks that will help investigate factors that are central to patients' adoption and use of consumer e-Health services in primary health care setting, and explain how these factors influencing patients' intention to use healthcare innovations. Understanding what hinders, what determines and what drives patients' acceptance of consumer e-Health services is important in both promoting acceptance of the systems by the patients and encouraging the primary care sector to invest their resources in innovative consumer e-Health applications. This study aims to obtain this information by evaluating a particular type of consumer e-Health system in a primary health care clinic.

Based on the extensive review of the relevant literature, several research propositions were proposed and a research model was developed. Chapter 3 presents a detailed description of the research propositions and the research model.

CHAPTER THREE. RESEARCH MODEL AND RESEARCH METHODOLOGY DEVELOPMENT

In this chapter, the previous findings are integrated into the research model, which, through an empirical case study, will seek to provide insights about the feasibility of introducing consumer e-Health services in the primary health care setting. This chapter starts with an outline of the development of the research propositions and research model. This is followed by a detailed description of each step of the research process, including research settings, consumer e-Health system development, data collection, analysis and synthesis. Finally, some issues that could influence the quality study and ethical consideration are discussed.

3.1 The Research Propositions and Research Model

The literature review presented in Chapter 2 suggests that Rogers' Diffusion of Innovation Theory is a well-established and powerful model for conceptualization of the process of the technology adoption. This is because, in comparison with other technology adoption theories, Rogers' theory (1995) is more comprehensive in providing an in-depth theory about the influences of socio-technical factors on adoption. In particular, it covers the communication channels, the attributes of innovations, the characteristics of adopters and the social system [132]. In addition, by recognizing that adoption of innovation is a gradual process, Rogers' theory (1995) provides a solid framework for longitudinal research on the process for patient adoption of consumer e-Health services [132]. Hence, the theoretical concepts from Rogers' Diffusion of Innovation Theory (1995) are employed as the basis for the development of research propositions and research model in this study.

3.1.1 The development of research propositions

3.1.1.1 Awareness of the consumer e-Health service and its benefits

According to Rogers (1995), the adoption or rejection of an innovation begins when "the consumer becomes aware of the product" [132]. In the context of e-Health, Cao et al. (2001) reported that, in order to increase the adoption of an online e-Health service by patients, the information about the availability and benefits of using this online health service should be adequately disseminated in a more efficient way [166]. Woodward et al. (2014) conducted a qualitative study to examine the adoption of e-Health innovations by healthcare workers in post-conflict settings [167]. Their study reports that an important characteristic for the adoption of innovative e-Health services is creating awareness among consumers about the services [167]. Therefore, the findings and observations of these studies lead to the following proposition:

P1: Patients are not adopting consumer e-Health service because they are not aware of the availability of the service or benefits it offers.

3.1.1.2 Perceived attributes of the consumer e-Health service

As previously explained, consumer e-Health can be considered as a technological innovation which comprises both software and hardware components. Moore and Benbasat (1991) identify that technological innovations must be easy to use to ensure consumer acceptance [137]. Davis (1993) explains that ease of use is an important characteristic from the consumers' perspective for the adoption of innovative services [103]. According to Venkatesh et al, (2003), ***Ease of use*** in the TAM model is an antonym of complexity from Rogers' Diffusion of Innovation Theory [101]. Rogers' analysis of diffusion shows that complexity is an important factor determining users' adoption of innovative services [132].

In addition, Moore and Benbasat (1991) suggest that an innovation is perceived as useful if it delivers advantages over its predecessors [137]. This implies that ***Perceived Usefulness*** in Davis' TAM is similar to the construct relative advantages from Rogers' Innovation Diffusion Theory. Although Davis' concept of ***perceived usefulness*** does not contain the term "relative", the definition of the construct is based on the relative terms of "capable of being used advantageously" [103, 137]. Venkatesh et al. (2003) suggest that ***perceived usefulness*** has impacts on both the individual's intention to use and attitude towards use [101]. Therefore, the above findings lead to the following proposition:

P2: Patients are not adopting consumer e-Health service because they do not find that it is useful or easy to use.

3.1.1.3 Accessibility of computers/the Internet

The availability of access to computers/the Internet is a prerequisite for consumer adoption of online services [168]. Previous studies suggest that access can be critical in the online consumer context, and lack of access to computers/the Internet can be one of the possible reasons for slow adoption of technological innovations [168-171]. Karahanna and Straub (1999) employed an attitudinal variable called ***perceived accessibility*** to investigate the consumers' adoption of an innovation at the early adoption stage [171]. Rich and Shook (1988) use an objective variable – ***actual access***, to measure the individuals' physical access to an information source [170]. Their studies found support for the hypothesized effect of accessibility on the early stage of adoption [168, 170]. Hence, this study hypothesises that a lack of access to computers/the Internet would make it impossible for consumers to adopt e-Health services. Accordingly, this leads to the following proposition:

P3: Patients are not adopting consumer e-Health service because they do not have convenient access to computer/the Internet.

3.1.1.4 Change from currently familiar ways of using healthcare services

Studies show that diffusion of new technologies often encounters a certain scope and level of resistance to change from the present way of practice by the target population [172, 173]. As explained by Rogers (1995), if an innovation is compatible with the individuals' familiar ways of doing things, it becomes less uncertain in its use [132]. In Rogers' Theory (1995), compatibility is defined as "the degree to which an innovation is perceived as consistent with the existing values, past experience, and needs of potential adopters" [132]. Chen et al, (2002), integrated compatibility into TAM to study online consumers' adoption behavior [172]. Their study find that compatibility has a significant direct impact on attitude towards use [172]. Vijayasarathy (2004) reports that compatibility appears to be a stronger determinant than perceived usefulness, and view it as a primary driver in the online environment [173]. In the context of e-Health, Chau and Hu (2001) conducted a comparison study to investigate physicians' adoption of telemedicine technologies [174]. Their study reports that a person who perceives using e-Health to be compatible with his/her present way of operating, is more likely to regard the service as being useful [174]. In addition, their study reveals that customers may not be prepared to change from their present way of operating unless the new technologies fulfil their specific needs [174]. Therefore, in line with Rogers' Theory, the following proposition is proposed:

P4: Patients are not adopting consumer e-Health service because they do not want to change from currently familiar ways of operating.

3.1.1.5 Previous experience of using health-related online services

Studies show that individuals' computer literacy and previous experience with the Internet will most likely affect their beliefs, attitudes, and intentions to use online services [175-179]. Pavlou (2002) finds support for integrating an individual's ***online experience*** as an important construct in the TAM rather than only as a moderating factor [176]. Moon (2004) identifies that prior experience with the Internet is an important characteristic from a consumer perspective in the adoption of e-commerce services [178].

In addition, studies suggest that consumers' perception of a technological innovation will change over time in their process of using the innovation [102, 171, 177]. Karahanna et al. (1999) report that experience with the system will impact on the social influence on the individuals' adoption behavior [171]. This is because the individuals will become more confident with the system as they gain experience while using it [171]. Another study on consumers' acceptance of online service delivery identifies the experience as an important reason for the slow adoption of online e-government delivery services [177]. Hence, in line with the previous research, the following proposition is proposed:

P5: Patients are not adopting consumer e-Health service because they do not have previous experience of using health-related online services.

The five propositions proposed and their relationship to the adoption of consumer e-Health services is illustrated in Figure 3.1. Although there could also be other factors influencing the non-adoption of consumer e-Health services, e.g. the security and safety of the health information, this study focuses on the above five propositions because the consumer e-Health services investigated in this study does not contain sensitive personal information.

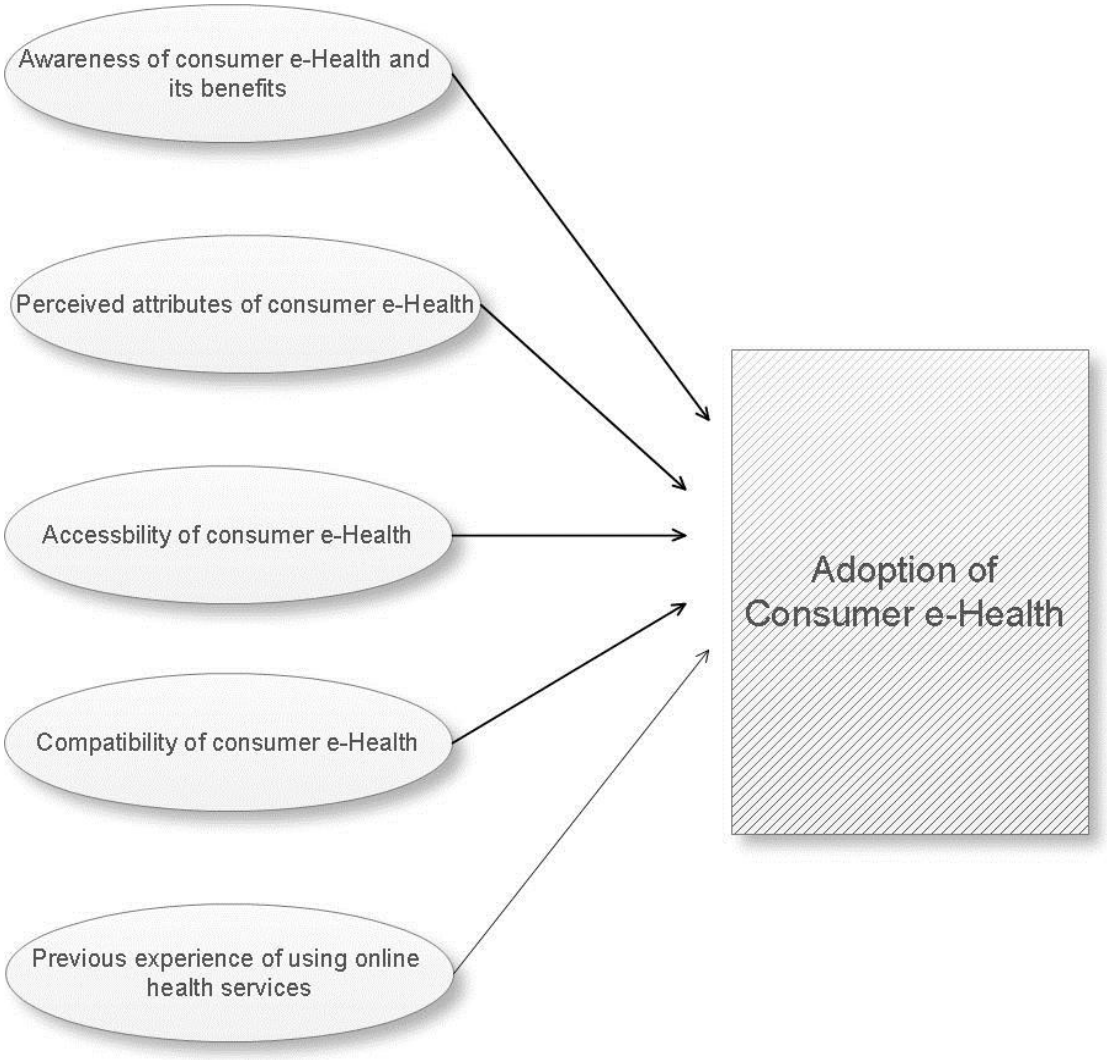

Figure 3.1 The research model for adoption of consumer e-Health services

3.2 Research Methodology

3.2.1 An overview of research methodology

In information systems studies, the commonly used research methods include: exploratory or descriptive case study, quantitative, qualitative or mixed methods (including both quantitative and qualitative), empirical, experimental and simulations [180]. Each type of research method comprises different research tools that can be employed to address specific research questions [180]. The determination of which

method to employ is dependent upon the nature of the research questions, as well as the feasibility to implement the research methods [180]. In this study, the research questions are directly related to patients' acceptance and usage of consumer e-Health services. It requires a holistic, in-depth investigation to be undertaken through a suitable research method to ensure that appropriate results can be drawn to address the research propositions and answer the research questions. In order to acquire and closely examine the data within the specific context – consumer e-Health in primary health care – this research has been operationalized into a case study research protocol that serve as a mechanism to produce appropriate study's results. By using the case study method, researchers are able to select a small geographical area and very limited number of participants as the subjects to investigate contemporary real-world phenomenon through detailed contextual analysis [181].

In addition, the purpose of this research is to identify and analysis factors that influence patients' acceptance and use of a particular type of consumer e-Health service. In the scope of the investigation, a research model is advanced that describes patients' attitudes towards the acceptance or rejection of the consumer e-Health service. During the development stage of the research methodology, exploratory techniques are used. This is because exploratory research is to develop better understanding of a phenomena or situation to be tested [182]. Thus, this research is characterized by an experimental, descriptive and exploratory research design. The entire process of developing the methodology is illustrated in Figure 3.2.

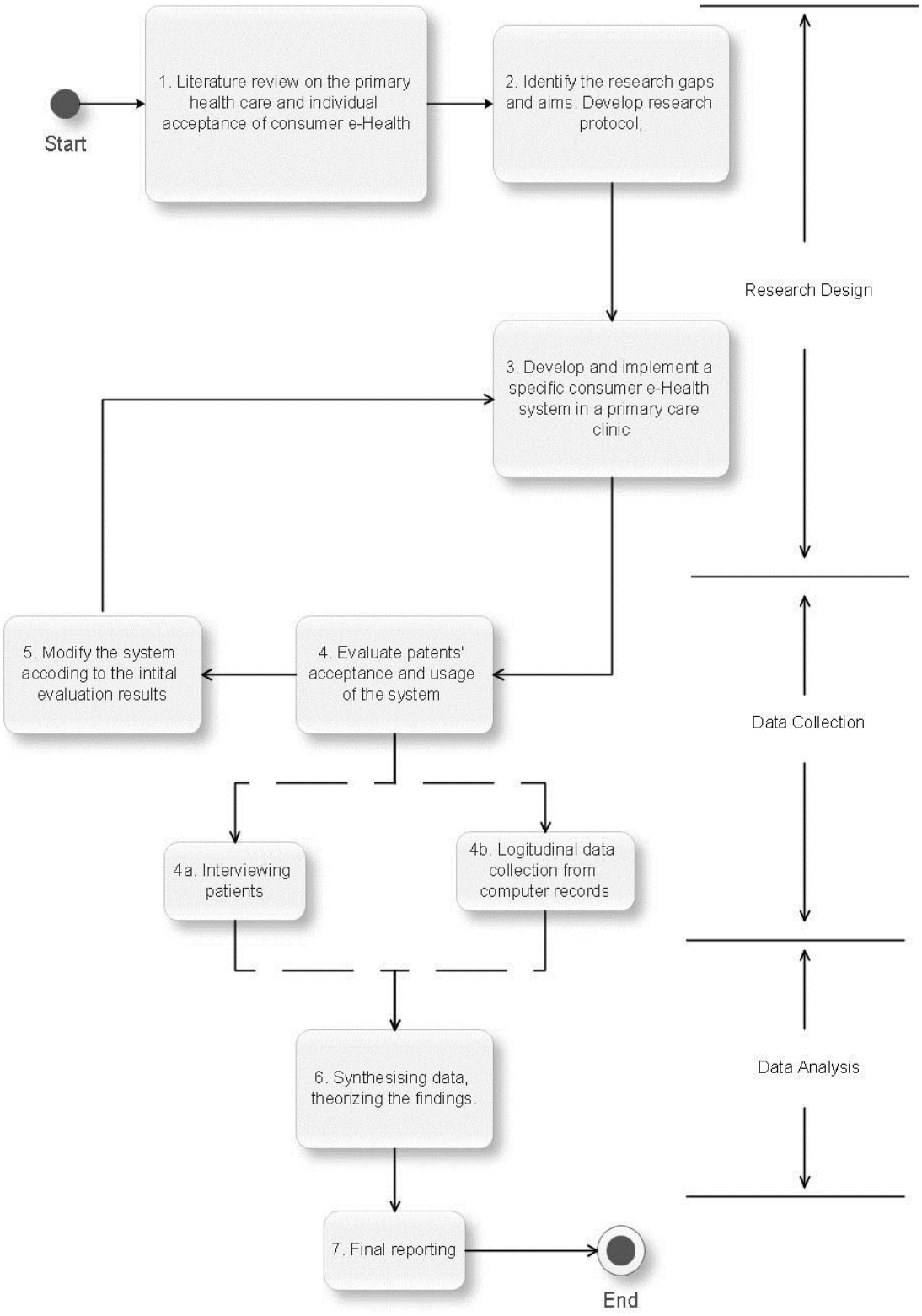

Figure 3.2 The process of developing research methodology

As shown in Figure 3.2, the proposed research comprises three phases: research design, data collection and data analysis.

The start of Phase 1 was an extensive literature review on the topic of primary health care and individuals' acceptance of consumer e-Health. In step 2, discussions with the academic supervisors and colleagues were conducted to extract valuable information to construct the research protocol. The research aims and questions were identified in this step. Discussion with the industry partner, who partially sponsored the project, led to the identifications of the need to design and develop a specific consumer e-Health system. Step 3 focused on the consumer e-Health system design, driven by the identified research aims and questions. During this stage, a specific consumer e-Health system was developed and implemented in the partner organization. It aims to improve the operation of the primary health care clinic and provide the case for the study.

In Phase 2 data collection, the empirical data was collected from two data sources: interview data (Figure 3.2, Step 4a), and computer log records (Figure 3.2, Step 4b). In addition, the initial evaluation results were used to inform the modification of the implemented e-Health system (Figure 3.2, Step 5).

Phase 3 is comprised of two steps: (1) synthesizing and theorizing the findings (Figure 3.2, Step 6), and (2) publication and final thesis writing (Figure 3.2, Step 7). Rogers' innovation diffusion theory was used as the conceptual framework to help the researcher to identify and analyze the factors influencing patients' acceptance of consumer e-Health services and their ongoing use of the services. The following sections provide a detailed description of the research setting, the methods and approach taken in each step of the research process.

3.2.2 The motivation of applying the socio-technical approach to the design of consumer e-Health system

To date, both design and evaluation of health-related information systems or services are often conducted without appropriate consideration of the complex relationship between people enacting healthcare practice and computer-based systems [183-186] [187-189]. Anderson (1997) suggests that

"*Past experience suggests that efforts to introduce clinical information systems into practice settings will result in failure and unanticipated consequences if their technical aspects are emphasized and their social and organizational factors are overlooked. ... Several decades of experience with computer-based information systems make it clear the critical issues in the implementations of these systems are social and organizational, not solely technical*" [185].

Consumer e-Health is a "consumer-driven" or "consumer-centered" care model which places greater emphasis on providing consumers with better access to various healthcare services [14] [190]. It is a multidisciplinary field, involving computer science, information technology, system engineering, medical and social sciences [187, 191]. In addition, as is described in Chapter 2, the information exchange in primary health care involves different social context and human activities [54, 95]. In general, the information process in primary health care can be divided into two categories [54]. One relates to the information exchange between GPs and other care providers [54]. The other category, however, is directly related to diagnosis and therapy. The information process in this category proceeds between care providers and patients, through which the patient's healthcare information is obtained [54]. As these processes involve rich information and views on the operation of consumer e-

Health, the problem situation in both processes can be seen as belonging to the 'ill-structured' human activity system [4, 17].

To incorporate a consumer e-Health system in primary health care settings, there is a need to analyse and understand its problem situation at a high conceptual level, rather than at the level of technology transfer. Thus, the 'socio-technical system thinking' approach is of primary importance for satisfying the conceptual prerequisite of problem identification and understanding [192] [187, 189]. Berg, et al. (2003) indicate that medical work should be seen as a social, real-life phenomenon, and technology is the social process which has great impact on the organization [187]. In addition, he advocates that the design of health information systems should be a socio-technical development process, in which human factors play an important role in the whole process [193]. El-Hassan et al. (2008) proposed a socio-technical framework to model human-computer interaction in health care practice [189].

As discussed above, the problem situation in primary health care requires an approach guided by socio-technical thinking. Based on a review of the relevant methods and theories within 'socio-technical system thinking' literature, the Soft Systems Methodology (SSM) is adopted and used as a conceptual model to guide the design and development of a new and evolving type of consumer e-health system for this project. The following sections provide a brief review of SSM.

3.2.3 The concept of Soft Systems Methodology

As healthcare information technology matures, a range of problem solving methods that encompass the idea of 'socio-technical system thinking' have been proposed and used in the study of healthcare information systems [186, 187, 189, 194-196].

Among them, Checkland's soft system methodology (SSM) is one of the most popular research frameworks used to analyse the problems that "*cannot be formulated as a search for an efficient means of achieving a defined end; a problem in which ends, purposes are themselves problematic*" [194]. It has potential to develop operational models to accommodate different perceptions of the problems, which are not well-defined, at high conceptual levels. As Checkland (1993) points out:

"*SSM was developed because the methodology of systems engineering, based on defining goals or objectives, simply did not work when applied to messy, ill-structured, real-world problems.*" [194].

This methodology places emphasis on human activities involved in purposeful systems [197]. In general, SSM can be described as a logical sequence of a seven-stage model (see Figure 2.6), through which the complexity of the problem situation in the purposeful system is investigated, described and eventually understood [194, 197]. Once an understanding of the situation has been achieved, then SSM allows the identification of change that is both systemically desirable and culturally feasible [194].

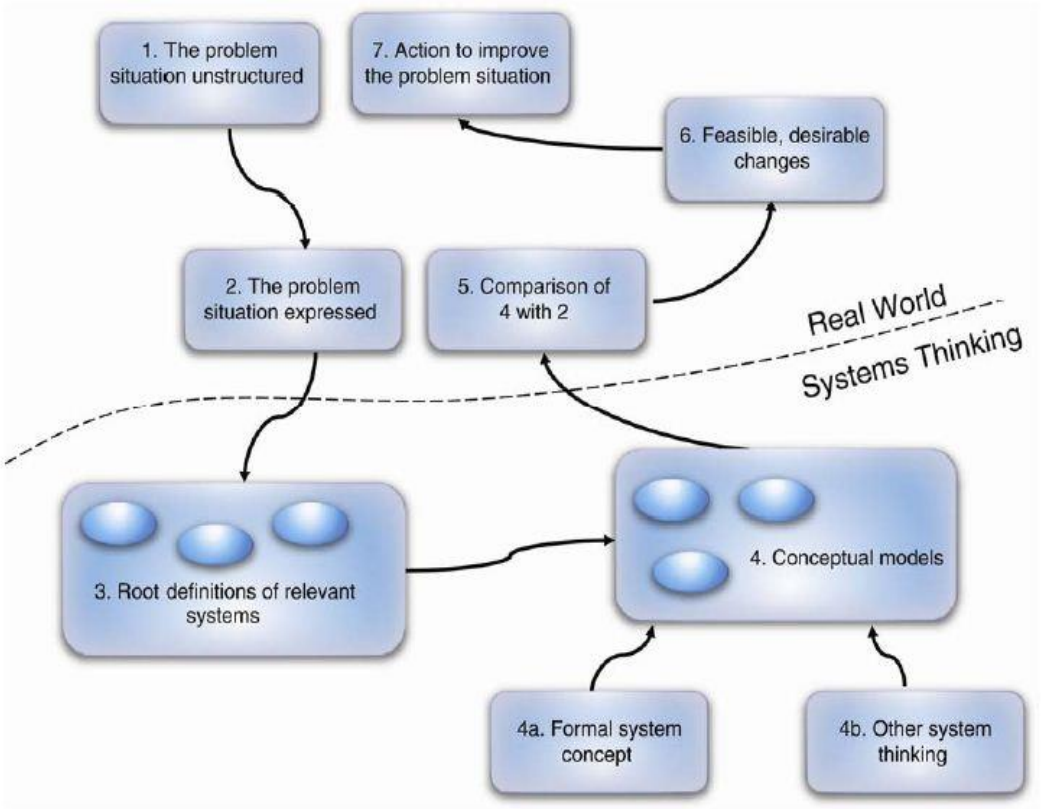

Figure 3.3 Problems solving steps in SSM [194]

The seven-stage model contains two types of activities: (1) human activities involved in the real-world problem situation, and (2) 'system-thinking' activities which may or may not directly be related to the problem situation. The seven-stage model can be summarized as three phases described as follow [194]:

- Obtain an insight into the real-world problematic situation by developing the richest possible picture of the situation. Stages 1 and 2 are included in this phase. The outcome of stages 1 and 2 is a 'rich picture' of the situation where the problem is perceived.
- Develop conceptual models to describe the nature of the purposeful system. Stages 3 and 4 are included in this phase. In stage 3, systems which might be relevant to the problem situation are identified in terms of 'root definitions'.

Then at stage 4, the conceptual models of the human activity system is derived based on the 'root definition'.

- Compare the conceptual models with the actual problem situation in the real-world to determine the best solutions. Bring these selected solutions into the as-is space to determine their feasibilities. This phase is carried out through stages 5 to 7.

In case these selected solutions are found to be inappropriate, or there is a mismatch between the model and practice and some improvement may be possible, then it is necessary to return to the problem identification stage and repeat the conceptual modelling process. The application of SSM in the study is presented in the following sections.

3.3 Research Setting

The case study was conducted in a primary health care centre, Centre Health Complex (CHC), located in Shellharbour, a suburban town on the South Coast of New South Wales (NSW), 100 kilometers south of Sydney. The medical centre provides family medical practices, specialist medical services, allied health services and wellness services to the local community. The staff included 19 physicians (17 GPs and 2 nurse practitioners), 7 allied health professionals, 10 specialists and 7 clerical front office staff.

According to the Australia Bureau of Statistics (ABS) 2011 census data, 63,605 people resided in the town where the study was conducted [198]. Of these, 49% (N = 31,158) were male and 51% (N = 32,447) were female [198]. The average age of the population at the study site was 37 years [198]. People aged between 18 and 64 years

made up 71.9% (N = 45762) of the population and people aged 65 years and over occupied 19.7% (N = 12576) of the population [198].

In addition, the ABS census data also suggested that 57.1% of the population at the study site reported working full-time, lower than the average of 60.2% in New South Wales (NSW) and 59.3% in Australia [198]. On the other hand, the unemployment rate was 13.2%, which was higher than the average level in NSW (11.6%) and the whole country (11.5%) [198]. The average weekly personal income of the study site was $479, lower than the average level of NSW ($561) and the whole country ($577) [198]. Therefore, the study site had a relatively low socioeconomic status in NSW and Australia.

3.3.1 The application of Soft Systems Methodology in the study

3.3.1.1 Identification of the problematic situation at CHC

In order to diagnose the requirements for the proposed consumer e-Health system, an SSM based approach was applied for understanding and formulating the problem situation at CHC. Informal discussions with GPs, allied health care providers and practice managers were undertaken so as to extract different views about the situation. The core themes around these discussions can be summarized as to identify: (1) the problematic areas in professional practices, (2) issues that contributed to this problem, (3) others sharing the same problem and (4) feasible solutions to the problem.

After gathering information from the health care providers and administrative staff, the problems impacting on the clinical practice at CHC were identified. These include:

- The current phone-call based appointment system was often congested and could not provide prompt service to a patient, making it difficult for a patient to make an appointment to see a GP through a phone call.
- The allied health and GP services are operated on different platforms and lacked effective and efficient means to exchange patient information.
- Discussion with the management at the clinic led to confinement of the scope of the project to address the problem of patient appointment services. This is because the allied health services at the clinic did not really use any integrated healthcare information systems to manage clinical information. Therefore, it was not feasible to design a computer-based solution to address the challenge of lack of patient information exchange among the allied health and GP services at the time of the study.

By analysing the above problematic situation at CHC, the root definition is determined based on Checkland's proposed CATOWE [199], which corresponds to customers, actors, transformations, owner, world view and environment constraints:

Customers: GP *clinic* system, allied health care system, patients, GPs, allied health professionals.

Actors: Front desk clerk, healthcare providers.

Transformations: Ineffective appointment system needs to be transformed to enable patients to make appointments through an online service. This is because, with the increasing adoption of the Internet as an integral part of daily work for primary care professionals, online appointment scheduling was seen by management of the CHC as an important strategy to reduce the limitation of the inefficient and incompetent phone-call based appointment service.

Owner: Management of the CHC, primary care providers.

World view: An efficient online appointment scheduling system integrated with clinical information system used by GPs can improve patient access to primary health care services and improve efficiency and save labour costs for the clinic.

Environment: Barriers to patient adoption of consumer e-Health, change in appointment process.

3.3.1.2 Root definition

As mentioned above, the problem environment in the research partner organisation – CHC – was an 'ill-structured' human activity system. The problem owners in this complex system include GPs, allied health care providers and practice managers who wanted to improve services through consumer e-Health technologies. Therefore, the root definition is stated as follows: An online appointment scheduling human/machine activity system owned and operated by primary care providers and management of the CHC that apportions a patient to a time slot within the practitioners' scheduling system and in line with the appointment/treatment process defined by GPs or allied health care professionals.

3.3.2 The design and development of the e-appointment scheduling system

This study proposed a mediation architecture to integrate multiple heterogeneous, distributed clinical database systems in CHC for the development of the patient e-appointment system. This architecture is organized into three logic layers: (1) the data presentation logic layer, (2) the data exchange logic layer, and (3) the data access layer. In addition, for the standardized data exchange between different layers, four web service modules were developed and used. These modules allow

standardized data exchange between different layers of the e-appointment system. This architecture is scalable and allows additional clinical information systems to be easily integrated into the system through the use of mediators and adapters. To add a new system, it is necessary to develop an adapter to implement the new system's functions and associate it to a mediator in the architecture. By doing this, integrating a new clinical system would not affect the existing local functions or alter the tasks of healthcare professionals. In addition, developing an adapter is facilitated by reusing Web Service technologies, which provide an effective solution to the interoperability issues essential for data integration tasks. A detailed description of the design and development of the e-appointment system is presented in Chapter 4.

3.4 Implementation of the Consumer e-Health System

The e-appointment service was developed and installed on a server at CHC at the end of January 2011. It provides patients with the opportunity for 'self-service' available 24 hours a day and seven days a week. A web link was placed on the home page of the medical centre and a click on it directed the user to the e-appointment service. Figure 3.3 shows the patient login web page.

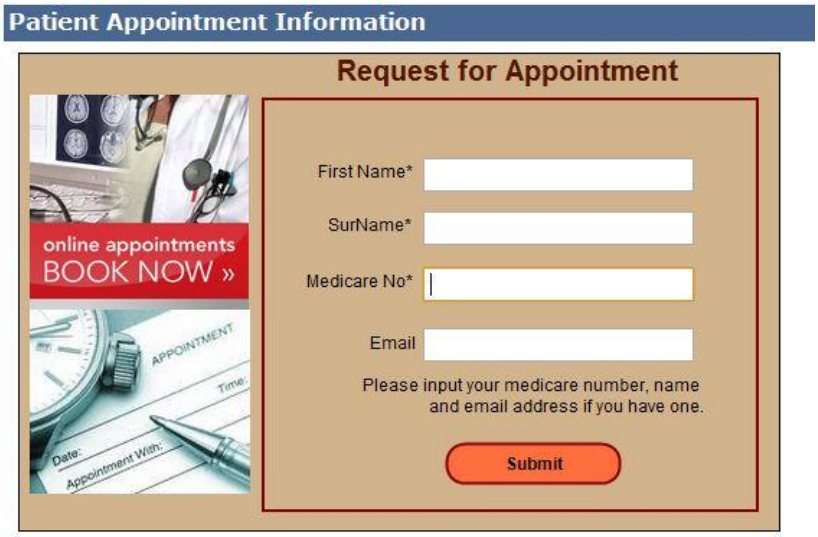

Figure 3.4 Patient login web page

Once successfully logged into the online appointment system, patients could select their preferred appointment date, time and doctors, as shown in Figure 3.4.

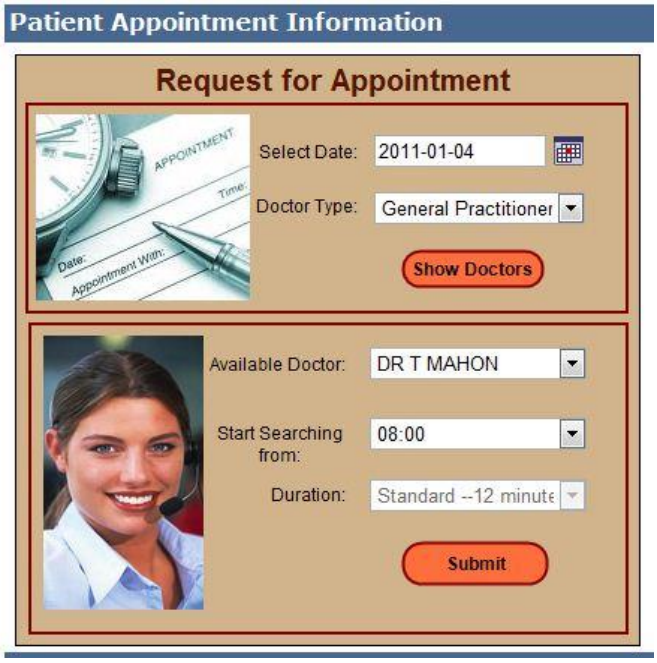

Figure 3.5 Online appointment options web page

After patients made their choice, a confirmation web page with print function would be displayed. The confirmation web page provides patients with the opportunity to reconsider their choices before the information is finally sent to the server database. After final choice was made, a confirmation e-mail was generated automatically and instantly sent to the e-mail address provided by the patient. This e-mail contained detailed appointment information, including the patient's name, doctor's name, appointment date, time and confirmation number. In comparison with a phone-call based service, the online appointment system had the advantage of allowing patients to instantly review and print out their appointment information. Figure 3.5 shows the appointment confirmation web page.

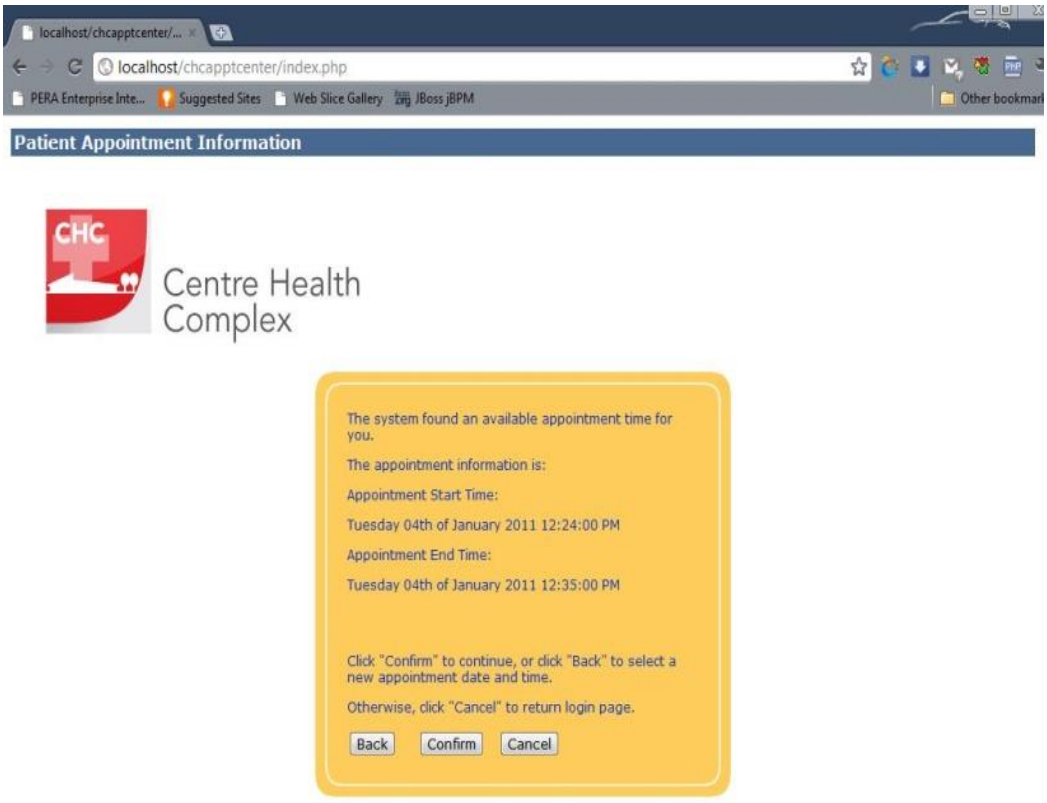

Figure 3.6 Appointment confirmation web page

Information about the e-appointment service was disseminated to patients through the following channels: (1) fliers left at the reception desk, (2) posters placed in prominent locations in the medical centre, (3) an advertisement on the CHC web site, and (4) a voice message played during the phone call waiting periods (implemented six months after online system implementation). The information disseminated included the web link of the e-appointment service and the steps to follow to make an appointment using it.

At the time of the field study, CHC provided a patient with three options for appointment making: phone-call, online self-service and walk-in services

3.5 Methods of Data Collection

3.5.1 Qualitative interview data collection

3.5.1.1 Study design

This study used both qualitative and quantitative research methods. To obtain detailed, in-depth qualitative data, a semi-structured interview was conducted. The interview questions were designed to address the acceptance and usage issues suggested by Rogers' diffusion of innovation theory and research propositions. In general, six issues are captured in each interview: (1) the patient's basic demographic information, including age, education level and employment status, (2) their awareness of the e-appointment service and the communication channels through which the information was received, (3) their perceptions of the e-appointment service compared with phone-call based appointment making, (4) their preferred method to make appointment with GPs: phone-call, online appointment or walk-in the clinic, (5) prior experience of using online healthcare services, and (6) their intention to use the e-appointment service in the near future. An overview of the

interview questions used for collecting qualitative data in the study is outlined in Table 3.1. A complete questionnaire survey of the e-appointment system is presented in Appendix A.

Table 3.1 An overview of the interview questions

Issues to be captured in each interview	**Interview questions**
Basic demographic information	- Gender? - Would you mind telling me how old you are? - Could you please tell me your educational background? - Are you working right now?
Awareness of the e-appointment service and the communication channels through which the information was received	- Did you know that we have an online appointment system? If yes, how did you find out?
Perceptions of the e-appointment service compared with phone-call based appointment making	- Did you use this online appointment system for making your appointment today? • IF YES: • Do you like to use it? • Is it easy to use? • Are you happy with it as it is or do you have any suggestions for improving it? • On a scale of 1 to 10 where 1 means 'not at all' and 10 means 'very satisfied'. How would you rate your satisfaction with the CHC online appointment system? IF NO: • Have you ever logged onto the online system? • Why didn't you use it this time?
Prior experience of using online healthcare services	- Do you use the internet to search for medical or health-related information? Why? How often would you say you do this?

	- Could you be more specific about which types of information you look for on the web?
Preferred method to make appointment with GPs	- Compare online booking with ringing reception at CHC directly, which way do you prefer to make an appointment: - by phone, - online - or just walking in? Why is that?
Intention to use the e-appointment service in the near future	- Would you like to use online appointment service next time? - Now that you know about the online appointment system, do you think you would use it for making appointments? - Would you recommend the CHC online appointment system to your friends or family who has computer access? Why or why not?

This study was sponsored by the University Research Committee (URC) Internal Industry Linkage Grant Scheme. Central Health Complex was the industry partner organization that partially funded the study. The survey was approved by the University of Wollongong/South Eastern Sydney & Illawarra area Health Service Human Research Ethics Committee. The semi-structured interview guide was reviewed by the owner of the medical centre, the practice manager and a general practitioner (GP). It was then trialled on three patients to ensure they understood all the questions and could provide relevant answers to these questions. Afterwards, the interviews were conducted in the medical centre from April 2011 to May 2013.

3.5.1.2 Study procedure

The first survey was conducted three months after the system was implemented, from April to June 2011. The time of the survey was decided based on the research

group's experience with other e-Health system implementation studies, which was also confirmed by Esther et al. (2011) [44]. In order to understand whether a patient's perception of the system would change over time when they gain more experience with using it, the survey was repeated three times, from June to August 2011, from October to November 2012 and again from April to May 2013.

In each interview, the researcher approached a patient who was sitting in the waiting area, appearing not to be engaged in any activities. The researcher explained the purpose and procedure of the interview, then gave an information sheet with written explanation to the patient. Only after oral consent was given by the patient, would an interview start. Each interview lasted about 10 to 15 minutes and was audio-recorded with the interviewee's permission. The interview stopped when theoretical saturation was reached [200].

For the protection of patient privacy, each interviewee was given a unique number with the form of 'PID_', followed by three digital numbers, for example, 'PID_001' represents the first patient who participated in the interview.

3.5.2 Quantitative computer log data collection

3.5.2.1 Study design

The computer log data provides a complete and accurate longitudinal data set about the variation of continued usage of the e-appointment service over the whole study period. Therefore, in addition to the interview, appointment log data was collected from the online appointment database. The online appointment database was built based on Microsoft SQL Server 2008. It stores each patient's online appointment information, including date, time and the name of the GP to be visited.

3.5.2.2 Study procedure

A set of data searching/results export SQL programs were developed and used to extract the online appointment information from different data tables. The search results were automatically exported to the Microsoft Excel worksheet, which was used for further data analysis.

Computer log data collection was conducted from January 2011 to May 2013. Twenty nine months of appointment log records were captured and analysed to ascertain the patients' usage of the e-appointment system.

3.6 Methods of Data Analysis

3.6.1 Qualitative interview data analysis

Following the qualitative data analysis technique suggested by Miles and Humberman [201], each interview was transcribed verbatim into a word processing document. The transcribed data was then carefully read and divided into meaningful analytical units that were relevant to the research aims [202]. By using the method proposed by Zhang et al. (2012), the analytical unit was identified and a code was assigned to signify this particular unit [202]. Each meaningful unit was coded into different sub-categories and then grouped into the categories that were framed according to Rogers' Innovation Diffusion Theory. For example, for the question "which method do you prefer to use to make an appointment", one interviewee responded that "I would prefer to use the phone because I prefer to speak to someone and confirm". This statement was coded as "prefer phone-call for oral communication and confirmation". Another interviewee answered "I will probably use the phone. I found it is easier to use the phone" was coded as "prefer phone-call because its ease of use". Then these two units were both placed in the category of

"preference for phone-call", but with different sub-categories "prefer oral communication" and "phone-call is easier than e-appointment service". This process was applied repetitively to all of the transcribed data until the overall coding was completed [201, 202].

Each interview was double-checked in order to prevent a patient being repeatedly interviewed in different survey periods. Therefore, although the interview data was collected in four stages, the qualitative interview study was not treated as a longitudinal study.

Statistical analysis was conducted in SPSS20 in order to assess the influence of demographic factors on perceptions. Spearman's correlation test and Chi-square test were conducted to measure associations and differences in proportions between groups. Statistical significance was set at P-value < 0.05.

3.6.2 Quantitative computer data analysis

In order to investigate patients' continued usage of the EAS, quantitative thematic analysis with coding via Microsoft Excel was used to analyse the computer log data. The analysis results were categorized and coded based on Roger's innovation-decision model and proposed research propositions. For example, one patient registered as an online appointment user but never used this service during the whole study period, this patient was coded as 'logged into the web site but never used'. Where a patient used the electronic, as well as the phone-call/walk-in appointment service, more than once, this patient was coded as 'used both online and phone-call services'. In total, the online appointment users were categorized into four groups, including (1) logged into the web site but never used, (2) tried once but never used

again, (3) used both online and phone-call services, and (4) only used online appointment system.

3.7 Summary of the Chapter

This chapter provides an overview of the research propositions and research methods. In order to understand the factors influencing patients' acceptance and usage of consumer e-Health services, a case study was conducted on a particular type of consumer e-Health innovation – a patient e-appointment scheduling system – in a primary health care clinical in a regional town in Australia. Research propositions were developed based on the effects of four potential contributing factors suggested by Rogers' Innovation Diffusion Theory and previous adoption studies: the communication channels, the attributes of the innovation, the characteristics of the patients and their social system. Data collected were the computer log records of patients who visited the medical centre during the 29-months study period and in-depth, semi-structured interviews with patients.

In order to build a specific consumer e-Health system in this medical centre, a Soft Systems Methodology (SSM) based approach was employed for understanding the real-world health service activities in relation to what is required for the desired system. The analysis of the problematic situation and formulation of the root definition led to the identification of an e-appointment scheduling system as the desired consumer e-Health system for CHC.

By applying the methodology for problem solving in Stages 1 and 2 of SSM, the requirements for the proposed system were uncovered. Based on the requirements, a comprehensive system architecture of the e-appointment system was proposed, and a prototype based on the mediation architecture was developed and implemented in

CHC. Next chapter provides a more detailed description of the development of the e-appointment system.

CHAPTER FOUR. DEVELOPING THE E-APPOINTMENT SCHEDULING SYSTEM BASED ON A MEDIATION ARCHITECTURE

As explained in Chapter 3, soft systems methodology was used as an operational framework to drive the system design decisions. As a result, an integrated patient e-appointment service development project in a local primary health care clinic was identified and a conceptual module of the proposed system was designed. However, the problems of heterogeneous information sources, the autonomy of different clinical specialties and differences in ownership of clinical practice have impeded the integration of health care information from different care providers. The emergence of Web Service technologies has brought the opportunity to address the above challenges. This chapter starts with a description of the concept of patient e-appointment service in healthcare sector. It is followed by the discussion of the challenges and integration issues for providing a unified appointment service in primary health care setting, including mediation architecture and Web Service technologies. Finally, a detailed description of the technological features of the proposed unified e-appointment system and its development process are given

4.1 Introduction

4.1.1 The e-appointment scheduling service in primary health care

4.1.1.1 The emergence of e-appointment scheduling service

In the Australian healthcare system, appointment making is the important first action when a patient seeks individual health care at primary health care facilities [203]. Patients need timely access to an appointment service for various reasons, including repeat prescriptions, full check-up, or consultation on more than one issue [203-206].

In a busy healthcare clinic, such as Centre Health Complex (CHC), a healthcare professional may schedule over twenty-five appointments in a single day. However, with an increasingly ageing population that requires increased healthcare professional services, and the shortage of doctors in semi-rural region, such as Shellharbour in New South Wales, appointment making can quickly become difficult and a challenge for health care providers who continue rely on phone-based appointment scheduling service [203, 205]. This is because the traditional telephone-based appointment scheduling process is a time- and resource- consuming process – staff spend too much time answering phone calls and managing appointments which is inefficient [204, 206]. In addition, telephone-based appointment scheduling requires patients to call the medical centre during office hours, which can be inconvenient for patients who work full-time [206]. Therefore, it often results in congestion on the telephone lines and restricts the efficiency of the care providers' work [205, 206].

Another important problem faced by clinics is that patients sometimes do not show up for their appointments. Missed appointments represent close to 10% of all appointments and this can lead to lower productivity for healthcare professionals and increased overall waiting-time for patients, which can decrease patients' satisfaction and increase their health risks [207].

As a response to these challenges, some primary health care clinics have recently started to provide patients with e-appointment scheduling (EAS) services that enable a patient to conveniently and securely make appointments with healthcare providers through the Internet [206].

According to the classification of Antonia et al. (2011), the e-appointment service is a typical type of consumer e-Health application: the use of the Internet for online

health services [19]. It is an Internet mediated agreement between a service consumer and the service provider for interacting at a certain future time and place for a specific purpose [208, 209]. Typically, there are two basic roles involved in an appointment making scenario – a service provider and a consumer. The service provider, such as a primary care practitioner, is the party offering the appointment service. On the other hand, the service consumer, such as the patient, is the party seeking a convenient time and location to receive the service.

According to Gupta & Dentona (2008), in the healthcare context, patients can access e-appointment service through a web portal 24 hours a day and 7 days a week. Once a patient's preferred date and time are selected, the system will automatically confirm the patient's appointment request and record the information in the database instantly without the involvement of health care providers. In comparison with a telephone-based appointment service, the EAS enables patients to easily schedule their appointments [206]. At the same time, by using this online scheduling tool, medical staff can identify new patients, allocate an appropriate time slot for each patient and easily manage patients' appointments [206].

4.1.1.2 Previous studies of patients' adoption of e-appointment service

With the prevalence of EAS services in the health care sector, studies on patients' acceptance and usage of EAS service have been conducted [166] [210]. Cao et al. (2011) conducted a qualitative study to examine patient usage of a web-based appointment system implemented in a Chinese public tertiary hospital. Their study found that, although many patients did not aware of the existence of the online appointment system at the time of the study, the use of the Internet for appointment making could significantly reduce the total waiting-time and improve patient

satisfaction with outpatient services [166]. In addition, being ignorant of online registration, not trusting the Internet, and lack of the ability to use a computer were three main reasons given for not using the online appointment system [166]. Zhang et al. (2014) also reported that, despite the benefits of using the e-appointment service, many patients in a tertiary hospital in Shanghai still registered via the traditional method of queuing, suggesting that health service providers need to use a more effective way to promote and encourage the use of the online system and to improve patient satisfaction with this service [210]. Recently, Horvath et al. (2011) reported a reduction of 2% in missed appointments for patients using an e-appointment system over two years [208].

4.1.2 Challenges for the design and development of an integrated e-appointment system

4.1.2.1 Healthcare information system integration in heterogeneous environment

According to Ralf (2009), to implement e-appointment service to consumers, the information infrastructure should meet the following requirements: (1) a standardized access to the electronic calendar data inside the service provider, (2) an overall operational policy and implementation that enable secure data exchange between service providers and consumers, (3) a mediator module that provides routine functions to relate the front-end user functions with the backend database, and (4) an organizational responsibility to set up the routine functions which enable patients to retrieve information from the internal electronic database and operate the front-end applications [211].

However, the design and implementation of an integrated healthcare information system (HIS) that supports the retrieval of patient information from different systems used by different health care providers are still difficult tasks [85]. This is due to the

fact that the design and implementation of HIS were often made at a specific clinic department level, with each department choosing technologies and solutions based on their own needs and beliefs [83]. This mean that, healthcare organizations often own a large number of heterogeneous information systems that are fragmented and poorly integrated [83, 84].

In addition, healthcare providers choose technologies based on the task-specific capabilities of a specific system, rather than the integration of all systems in the solution space [212]. Therefore, many HIS were developed with different computer languages, run on different platforms with different hardware and software configurations, and operated by different Database Management Systems (DBMS) [85, 213, 214]. For example, in CHC, GPs use Medical Director and Pracsoft systems, which were installed on the Windows Server platform, for various tasks, including patients' appointment scheduling, bulk billing, and patient medical information recording and updating. All operations are managed by Windows SQL Server. However, the allied health professionals use Groupware system, which was installed on the Linux Server for patient scheduling and medical recording. These systems are frequently heterogeneous because the original design focus is on data transfer and not on data integration and synchronization [212, 215, 216], making it difficult for information sharing and exchange. Therefore, this study needs to develop an integrated patient e-appointment scheduling system that could combine all the heterogeneous systems that make all medical data accessible for the relevant individuals who needed it at every point of care.

From a management perspective, achieving such integration requires the establishment of a loosely coupled and broadly-based information infrastructure in which different health care providers collaborate in pursuit of a common set of

objectives [217, 218]. From a technical perspective, this raises a number of challenges associated with traditional integration approaches, including heterogeneous interoperability, transfer information through the Internet, loosely coupled connections amongst various applications, flexibility and reusability of the system [218, 219].

4.1.2.2 Design considerations

Traditional integration approaches, such as Common Object Request Broker Architecture (CORBA), Java Remote Method Invocation (RMI) or Microsoft Distributed Component Object Model (DCOM), are platform and language dependent. These approaches are used to produce tightly coupled connections to address the specific integration issues of one set of applications [220, 221] [220, 222]. As a result, it is difficult to develop integrated healthcare information systems with traditional approaches to support information sharing and exchange across the Internet [220].

Many studies have been conducted to address the above integration challenges in health care settings [223-227]. Some studies have introduced Web Service technology in the development of health information systems [228-230]. Web Service technology addresses challenges associated with traditional integration approaches by providing a unified platform with loosely coupled connections to support integration of disparate systems in the computer industry [231]. It uses a commonly-agreed, platform independent technological mechanism to assemble software components in a modular way and invoke services exposed by an information system [232, 233]. Web Services technology is built on a set of specifications, which includes Simple Object Access Protocol (SOAP), Web Services

Description Language (WSDL), and Universal Description, Discovery, and Integration (UDDI) [232]. As a result, any system capable of parsing text and communicating via a standard Internet transport protocol, such as HTTP, SMTP or XML, can communicate with a Web Service platform [234, 235]. Thus Web Services technology enables seamless integration of various clinical information systems in different settings to provide universally accessible medical services to patients [235]. Therefore, to achieve the goal of the study, a mediation architecture based on Web Service technologies was developed. It allows the integration of several autonomous, heterogeneous, distributed HIS in CHC with the aim of supporting information sharing and exchange without affecting the local function of each system. This architecture formed the basis of the proposed integrated e-appointment system to be implemented in CHC.

4.2 Method

4.2.1 Overview of the proposed mediation architecture for the patient e-appointment scheduling system

This study developed a mediation architecture for the patient e-appointment system based on a mediation framework proposed by Mrissa et al (2004) [228]. The advantage of the mediation architecture proposed in this study is to allow access to the heterogeneous and diverse information in clinical information systems which are connected by an intranet in CHC. It is composed of two central components: the mediator and the adapter. According to Mrissa et al (2004), the mediator can be used to describe, simplify and combine the clinical data from different clinical information systems for end users [228, 236]. On the other hand, the adapter operates as an intermediary between the clinical database systems and the mediators [228]. It allows

information exchange between a clinical database and mediator, and vice versa [228]. In this case study, the mediator was used to retrieve patients' appointment information from a variety of data sources and application domains. In addition, several mediators constitute a hierarchy module that support data exchange between the user interface and a large number of clinic data sources.

For fast, reliable development of mediators and adapters, it is preferable to separate the works of these two components as much as possible [228]. Therefore, a three-tier system architecture was developed to enable rapid application development with project maintainability in mind.

Figure 4.1 shows the proposed mediation architecture for the patient e-appointment system. It consists of three layers: (1) the data presentation logic layer defines how data from the mediator is arranged and displayed in the user applications. It is composed of user interface and e-Health applications; (2) the data exchange logic layer is linked to the front-end user interface and each clinical database system, and (3) the data access logic layer that is connected to the various clinical data sources.

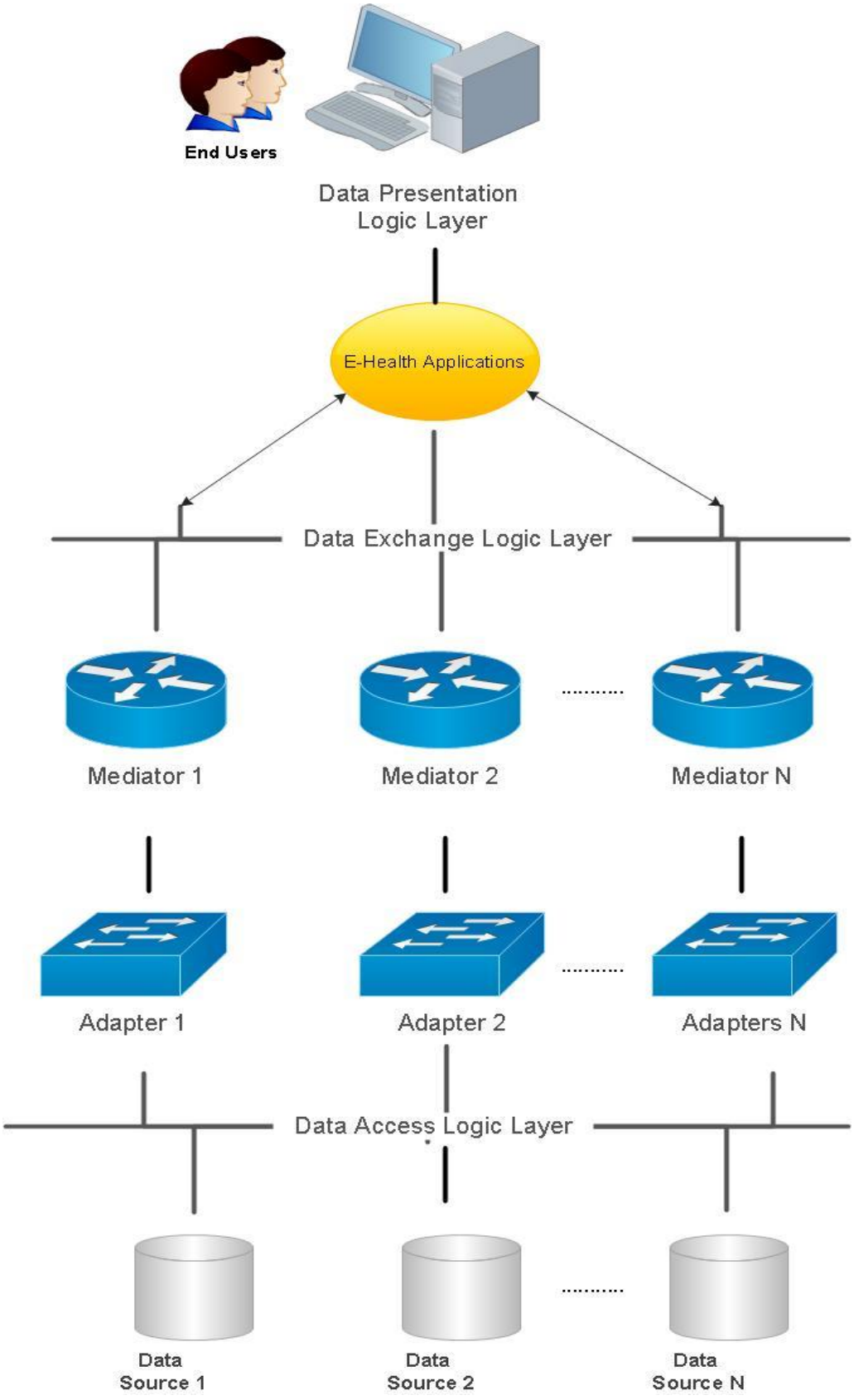

Figure 4.1 The proposed mediation architecture for the patient e-appointment system

The data exchange logic layer consists of a group of mediators and adapters. The mediator is designed to resolve the heterogeneous problems by presenting data in the format of the mediation model. It enables transparent access to different clinical data sources through a unified access interface – the adapter – and each adapter is linked to a unique clinical database system. The adapter is designed to retrieve the responses of queries submitted by end users and convert these results to the correspondent mediators in accordance with the requested formats and structures.

A user's appointment request is submitted to the clinical database through the mediator, and then is executed through the following steps: (1) a mediator sends each user's request to the database through the adapter, (2) the adapter converts each request into a local request in the format of the correspondent database, (3) the response from the clinical database is then converted by the adapter into the format of the mediator, and (4) the mediator receives the response returned from each database and sends it back to the e-Health applications, such as the e-appointment application (see Figure 4.1). A detailed description of data exchange is presented in the next section.

To integrate a new clinical database system, it is necessary to develop a specific adapter to provide a unique access interface to the new database system, and to support the implementation of the new system's functions. This new adapter is then registered in the proposed mediation architecture. In practice, in order to develop an appropriate adapter that supports a unique access interface to the database, it is necessary to explore and analyse the clinical database's structure and its conceptual model.

4.2.2 Data exchange in the proposed mediation architecture

The information flow occurs on the data presentation logic layer and data exchange logic layer. In order to separate data from the presentation logic layer, the Extensible Markup Language (XML) schema was used as the data exchange message syntax [237]. All integrated data in the data exchange logic layer is encoded in XML format, which makes it possible to protect the confidentiality of healthcare data. This data can then be easily decoded from the XML-based message and presented to the data presentation logic layer. Figure 4.2 shows an example of an XML-based message used in the mediation architecture.

Figure 4.2 XML-based message for e-appointment service

4.2.3 The solution to data integration – Web Service technology

In order to develop a unified e-appointment system which can operate seamlessly across a wide variety of heterogeneous clinical information systems, it is necessary to solve the interoperability issues raised in the data exchange process. With the prevalence of Internet technologies, Web Service brings an ideal solution to the issue of system interoperability [238, 239]. As a new type of software service, Web Service technologies are HTTP-based, modular self-describing and self-contained Web applications that can be published, located and dynamically invoked across the Web [239]. A detailed description of Web Service technology was presented in the

previous section. In this study, a set of Web Services components were developed and implemented to perform the data exchange and integration functions.

4.3 Implementation of the Proposed Mediation Architecture

4.3.1 The prototype of the e-appointment system

A unified patient e-appointment system was developed based on the proposed mediation architecture. It is designed to integrate a set of heterogeneous clinical information systems used by different health care professionals, including the GP system and allied healthcare information systems currently used in CHC. Each clinical information system can send and receive data according to its own data model. Figure 4.3 shows the architecture of the e-appointment system.

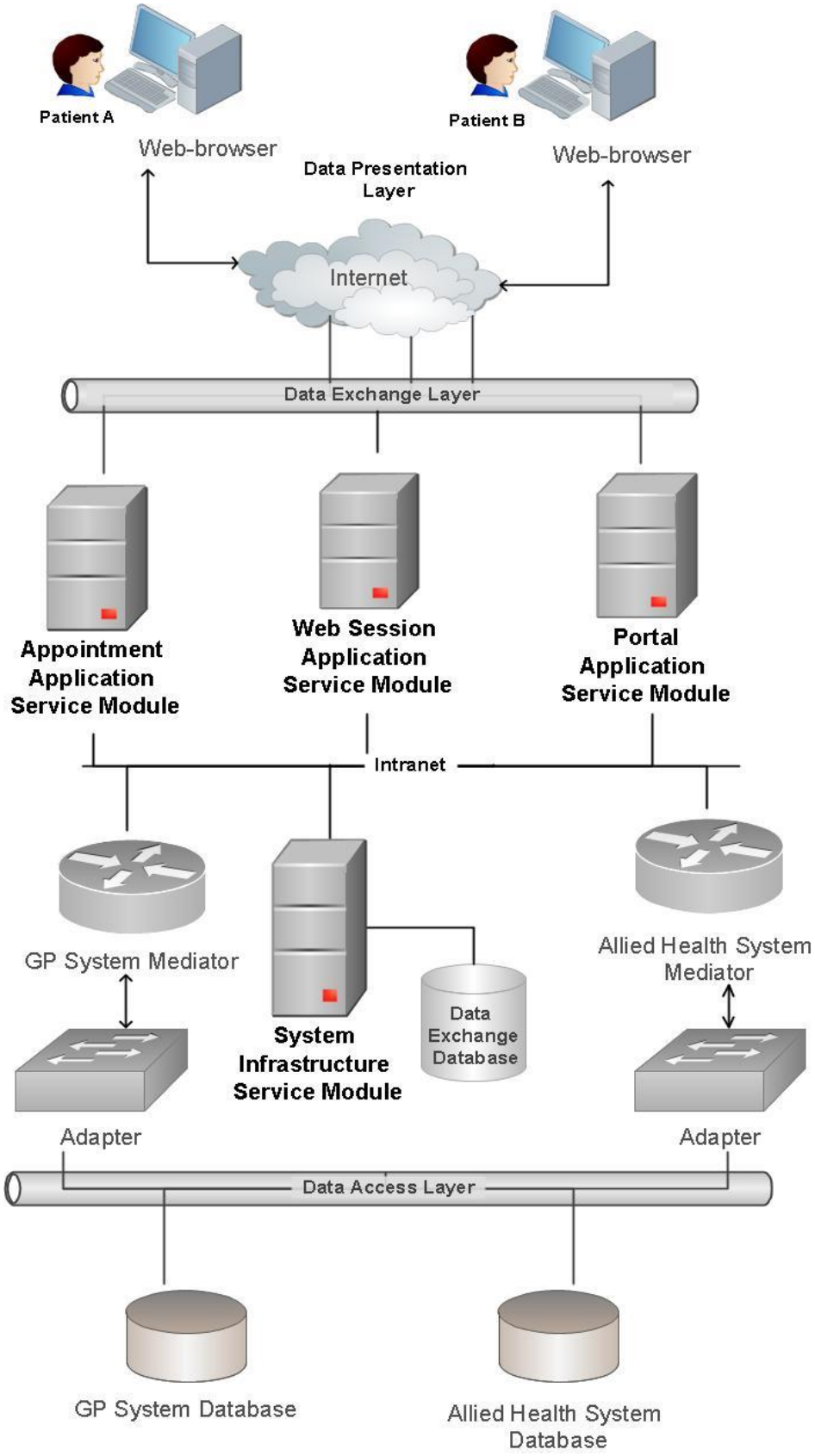

Figure 4.3 The architecture of the e-appointment system

It can be seen that the e-appointment system uses the proposed three-layer mediation architecture to integrate the existing clinical information systems. The following sections provide a detailed description of each layer.

4.3.2 Data Access Layer

The data access layer concerns two HIS: the GP clinic information system and allied healthcare information system, which are the heterogeneous and autonomous components that store various clinical information, such as patient healthcare records or practitioners appointment scheduling. The data access layer contains two database servers (Microsoft SQL Server and MySQL database server) and a set of SQL storage procedures to extract data from the relevant clinical system.

4.3.3 Data Exchange Layer

Data exchange and integration is done at the data exchange layer. Two mediators were developed: one is located between the GP system and data presentation layer (GP system mediator), and the other is located between the allied healthcare system and the data presentation layer (allied health mediator).

These two mediators served as the communication interface between the data access layer and data presentation layer. They were both used for all internal/external integration needs within a heterogeneous environment. Each mediator performs the same tasks, including locate, assemble, receive and assimilate the available appointment scheduling information requested by end users, such as patients. The key functions of the mediators include: (1) dispatching and receiving messages between data presentation layer and data assess layer, (2) assembly and assimilation of messages used by core clinical applications, (3) data logging and error/exception

handling, and (4) caching appointment data in the data exchange database in order to improve system performance.

The users' appointment queries are transmitted to adapters, and then, the adapters search for the relevant information in the clinical database servers from the local heterogeneous clinical database. Each adapter has the same interface with the mediator. The adapter allows the data to be adapted according to the needs of the e-appointment application.

In addition to the mediators and adapters, an appointment application service module, a web session application service module and a portal application service module were developed based on Web Service technologies and installed in the data exchange layer. These modules are used to connect to the Internet and exclusively handles the user requests for the various contents, including HTTP web pages, JavaScript or PHP functions. If the HTTP request is related to appointment scheduling, the web session service module will generate a dynamic web page to the server-side applications located at the appointment application service module. Then the appointment application service module will process the user's appointment query and send to the correspondent mediator. The key functions of appointment application service module include (1) decode/encode XML messages containing appointment information, (2) search available appointment slots and schedule patients' appointment requests, (3) send confirmation e-mails to patients, and (4) store/retrieve patient appointment in the data exchange database.

The portal application service module respond to user login and registration requests. In addition, it uses an MD5 hash generator to encrypt user login information. This encrypted login process ensures that only identified users can access the relevant healthcare information sources.

In order to support information exchange between the data exchange layer and the data access layer with an integrated data set, a system infrastructure service module was developed and used to store detailed information of each appointment made by a patient, including the timestamp of user login and access to the e-appointment system, each patient's Medicare number and each doctor's appointment information.

The e-appointment system was developed based on Microsoft .Net framework with C# language. The Microsoft .Net framework provides a simple and user-friendly way to create Web Service based applications. It allows application developers to generate complicated XML messages without requiring too much efforts in constructing and parsing data.

4.3.4 Data Presentation Layer

The data presentation layer is where the web page layout – how data from the data exchange layer is arranged in the web page – is defined. It consists of a set of web pages, text/CSS styles, images, banners and menu styles, which were developed in PHP, HTML and JavaScript languages. For the fast, reliable development of the data presentation layer, a PHP template system – Smarty template – was used. The principle of this PHP template system is to separate the application logic from presentation logic [240, 241]. This template system allows developers to pass the application logic to the template system in a single array and arrange the data presented in the web page accordingly [241].

4.4 The Information Process of the E-Appointment System

As illustrated in Figure 4.3, the e-appointment system contains four web service models, including the appointment application service module, web session application service module, portal application service module and system

infrastructure service module. These modules are used to define, manage, monitor and store the different information processes between the data access layer and data presentation layer. The main information processes, which occur between these modules, include user registration and identification process, appointment information retrieval process and appointment making process, as shown in Figure 4.5.

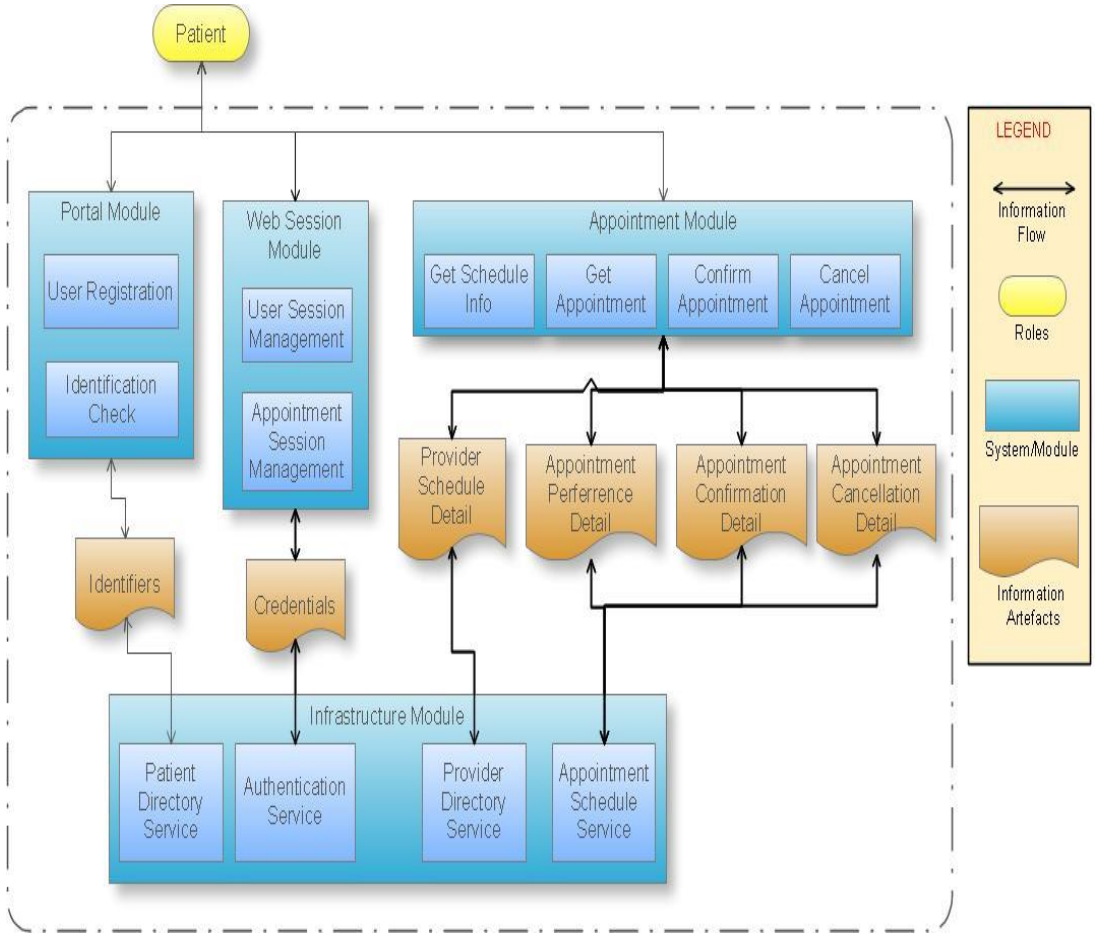

Figure 4.4 The information process of the e-appointment system

4.4.1 The user registration and identification process

The user registration and identification process involves the web portal module and system infrastructure module. The web portal module is used to retrieve the patients'

identities and their current status from the clinical database. Each patient's identity is verified by matching the patient login information with the records stored in the existing clinical database systems. To do so, a patient directory service is used to retrieve the patient information in the database. In case a new patient needs to access the e-appointment system, a user registration is invoked to generate a new patient registration request and to store the patient's personal information in the database.

4.4.2 The appointment information retrieval process

After an enquiry as to an available appointment is received by the data exchange layer, the relevant information about available appointment slots, all available doctors' names, doctors' work session timetables and their appointment schedule tables will be extracted from relevant clinical database systems and stored in the data exchange database for the rest of the appointment making process.

4.4.3 The appointment making process

The appointment module enables patients to customize their appointment with user-defined criteria, including types of appointment, preferred data, time and doctors. Once an available appointment slot has been found and confirmed, a confirmation e-mail will automatically be generated and sent to the patient's e-mail address through the appointment making process. In addition, this appointment slot in the clinical database will be updated accordingly through the process.

4.5 Summary of the Chapter

The problems of heterogeneous information sources, the autonomy of different clinical specialties and differences in ownership of clinical practice have impeded the integration of health care information from different health care providers. The same

challenges was identified at the CHC. Therefore, a mediation architecture was designed in this study to solve the problems of information sharing in a heterogeneous environment.

This mediation architecture is composed of three levels: the data access logic layer, the data exchange logic layer and the data presentation logic layer. In order to resolve the heterogeneous problems, a group of mediators and adapters were developed and used to extract data from various clinical systems and to support information exchange between different components of the e-appointment system. In addition, a set of web service modules were developed in order to support data exchange and integration.

The proposed architecture is scalable and allows any additional clinical information system that might be added in the future to be easily integrated into the e-appointment system developed in this project without affecting the local functions of other existing IT applications at CHC. After testing, the e-appointment system was installed on a server at CHC at the end of January 2011. It had provided patients with the opportunity to make appointments 24 hours a day and seven days a week. Patients could access the e-appointment service through a set of web pages hosted at the web site of the medical centre. The results of data analysis about the patients' acceptance and usage of the e-appointment system are presented in Chapter 5.

CHAPTER FIVE. RESULTS OF DATA ANALYSIS

Chapter 4 provided a detailed description of the design and development of the e-appointment system. This chapter presents the findings about the patient acceptance and usage of the system over two and a half years. The data was collected from in-depth, semi-structured interviews and computer log records. The results are presented in the following sequence: (1) demographics of the participants and their use of the e-appointment system, (2) interviewees' prior experience of using online health services, (3) interviewees' awareness of the EAS and effectiveness of communication channels for disseminating the information, (4) variations in patients' continued usage of the EAS over two and a half years, (5) interviewees' perceptions of the e-appointment system, and (6) interviewees' intention to use the e-appointment service in the near future. This is followed by the discussion section and the summary of this chapter.

5.1 Demographics of the participants and their use of the e-appointment system

Fifty-one patients were interviewed in the first survey which was conducted three months after the introduction of the e-appointment system. In the three follow-up surveys (from June to August 2011, from October to November 2012 and again from April to May 2013), 20, 32 and 22 patients were interviewed, respectively. This gave a total number of 125 interviewees, providing sufficient variation in age, gender and social status of the study population.

Table 5.1 provides an overview of the demographic profiles of the interviewees and patients recorded in the appointment database. During the four periods of face-to-

face survey, 125 patients between the ages of 18 to 78 years participated in the interview (see Table 5.1). These included 61 men (49% of the interviewees) and 64 women (51% of the interviewees). The average age of the interviewees was 38.7 years (SD 16.04 years). Accordingly, 75.2% of respondents (N = 94) were aged between 18 and 64 years, and 24.8% of respondents (N = 31) were aged 65 and above. A comparison of the participants' demographic profile with the Australia Bureau of Statistics (ABS) census data suggests that the sample was representative of the population in the study site.

Eleven percent of the interviewees (6 males and 8 females) used the e-appointment service in all four survey periods. This was much higher than the real number of online appointment users suggested by the computer log records stored in the database of the medical centre (see Table 5.1). Six interviewees who used the e-appointment service at least once were in the age group of 30 to 41 years, representing 19% of the population in this age group. Five interviewees were between18 to 29 years of age and 3 users between 42 to 53 years of age. None of the online appointment users was above 54 years of age.

According to the computer log records, from January 2011 to May 2013, 25,616 patients visited the medical centre through phone-call, walk-in or online appointment making services. Only 6% of them (N = 1554, 557 males and 997 females) had continuously used the e-appointment service to make appointments to see their doctors over the whole study period.

Table 5.1 Basic demographic profiles of interviewees and patients recorded in the appointment database, and their use of phone-call or online system to make appointment

		Usage of each type of appointment method by % (No.) of Interviewees		**Usage of each type of appointment method by % (No.) of Patients recorded in the database**	
		Using phone-call/walk-in only	Using online appointment service	Using phone-call/walk-in only	Using online appointment service
Age	18-29	86% (30)	14% (5)	91% (6402)	9% (631)
	30-41	81% (26)	19% (6)	91.5% (5211)	8.5% (485)
	42-53	89% (24)	11% (3)	95.5% (5003)	4.5% (234)
	54-65	100% (18)	–	96% (3842)	4% (160)
	Above 65	100% (13)	–	98.8% (3604)	1.2% (44)
Gender	Male	90% (55)	10% (6)	95.3% (11195)	4.7% (557)
	Female	87.5% (56)	12.5% (8)	92.8% (12867)	7.2% (997)
Education	Primary/Secondary /TAFE	92% (99)	8% (9)	–	–
	University	71% (12)	29% (5)	–	–
Work status	Full time	83% (54)	17% (11)	–	–
	Part time	100% (26)	–	–	–
	Unemployed	91% (31)	9% (3)	–	–
Total		89% (111)	11% (14)	94% (24062)	6% (1554)

In order to examine whether the users of the e-appointment system differed significantly from nonusers in terms of the demographic profile, including gender, age, education levels and employment status, a series of Spearman's correlation and

Chi-square tests were conducted. Table 5.2 shows the relationship between use of the EAS and gender. The Pearson Chi-Square test result shows that no statistical significant difference was found on the use of the EAS between males and females (p=.637).

Table 5.2 Chi-Square test on the use of the EAS and gender

	Male	**Female**	**Total**
E-appointment users	6	8	14
Phone-call/Walking-in users	55	56	111
Total	61	64	125
Pearson Chi-Square value = .223 Asymp.Sig.(2-sided) = .637			

Of the interview participants, 29% of the 17 interviewees (N = 5) with a university degree used the e-appointment service at least once. Of the remaining 108 interviewees (86.4% of the total respondents) who reported having a primary, secondary or certified technical education degree from the Technical and Further Education (TAFE) system in Australia, only 8% (N = 9) used this online service at least once.

The relationship between the educational level and online service usage was assessed by Spearman's correlation analysis. The result suggests that usage of the e-appointment system by male interviewees had a weak, yet significant positive correlation with their educational level (r_s (59) = 0.282, P = 0.031) (see Table 5.3). However, no such correlation was found for the female interviewees (r_s (62) = 0.118, P = 0.064) (see Table 5.4).

Table 5.3 Spearman correlation and Chi-square tests on the use of the e-appointment system by males and levels of education

	Using Phone-call/Walking-in	**Using the online appointment service**	**Total**
Primary School	29	2	31
Secondary School	14	1	15
TAFE	5	0	5
University degree	7	3	10
Total	55	6	61
Spearman correlation value = .282			
Pearson Chi-Square value = 8.859			
Asymp.Sig.(2-sided) = .031			

Table 5.4 Spearman correlation and Chi-square tests on the use of the e-appointment system by females and the levels of education

	Using Phone-call/Walking-in	**Using the online appointment service**	**Total**
Primary School	18	4	22
Secondary School	22	0	22
TAFE	11	2	13
University degree	5	2	7
Total	56	8	64
Spearman correlation value = .118			
Pearson Chi-Square value = 7.285			
Asymp.Sig.(2-sided) = .064			

The interview data shows that 52% of the interviewees (N = 65) reported working full-time, which was found to be similar to the ABS census data presented above. 21% (N = 26) worked part-time, and the remaining 27% of the interviewees (N = 34) were unemployed, which was found to be higher than that reported in the census data (13.2%).

The results also show that 17% of the interviewees (N = 11) who worked full-time had experience of using the e-appointment service. No part-time workers reported

using the system. The other 3 online system users came from the unemployed group, accounting for 9% of this population. A strong, positive correlation between employment status and usage of the e-appointment service was found for male interviewees (r_s (59) = 075, P = .012) (see Table 5.5). However, no such association was found for female interviewees (r_s (62) = 0.15, P = .110) (see Table 5.6).

Table 5.5 Spearman correlation and Chi-Square tests on the use of the e-appointment system by males and employment status

	Using Phone-call/Walking-in	**Using the online appointment service**	**Total**
Full time	36	6	42
Part time	9	0	9
Unemployment	9	1	10
Total	54	7	61
Spearman correlation value = 0.75			
Pearson Chi-Square value = 11.497			
Asymp.Sig.(2-sided) = .012			

Table 5.6 Spearman correlation and Chi-Square tests on the use of the e-appointment system by females and employment status

	Using Phone-call/Walking-in	**Using the online appointment service**	**Total**
Full time	18	5	23
Part time	17	0	17
Unemployment	22	2	24
Total	57	7	64
Spearman correlation value = .148			
Pearson Chi-Square value = 6.023			
Asymp.Sig.(2-sided) = .110			

5.2 Interviewees' awareness of the e-appointment system and effectiveness of communication channels for disseminating the information

In the first survey period, only 22% of the interviewees (N = 11) were aware of the existence of the e-appointment system (see Table 5.7). The number increased substantially to 55% (N = 11) four months after system introduction. It increased to 59% (N = 19) one year later, and then dropped to 23% (N = 5) two years after the implementation of the e-appointment system. It can be seen that there was an increasing trend of awareness of the e-appointment system over the one and a half years of the survey period. Simultaneously, the percentage of online service users among interviewees increased from 5.8% to 20% from the first data point to the second and remained similar at the third data point. However, more than 60% of the interviewees remained unaware of the e-appointment system over the entire survey period. Spearman's rank-order correlation revealed that there was a strong, positive correlation between interviewees' awareness and usage of the e-appointment system (r_s (123) = 0.508, P < 0.001) (see Table 5.8).

Table 5.7 Percentage of interviewees who were aware of and used the e-appointment system at each data point

Survey period	% (No.) of interviewees	
	aware of the online system / total Interviewees	**used the online service / total interviewees**
April 2011 – June 2011	22% (11/51)	5.8% (3/51)
July 2011– August 2011	55% (11/20)	20% (4/20)
October 2012–November 2012	59% (19/32)	19% (6/32)
April 2013 – May 2013	23% (5/22)	5% (1/22)
Total	37% (41/125)	11% (14/125)

Table 5.8 Spearman correlation and Chi-Square tests on awareness and usage of the e-appointment system

	Using Phone-call/Walking-in	**Using the online appointment service**	**Total**
Unware of the online system	84	0	84
Aware of the online system	27	14	41
Total	111	14	125
Spearman correlation value = .508			
Pearson Chi-Square value = 32.301			
Asymp.Sig.(2-sided) < .001			

Those interviewees who were aware of the e-appointment system reported receiving the information about the availability of this service through visiting the medical centre web site or through the voice message heard when making an appointment via phone. No interviewees appeared to notice the posters or fliers placed at the locations that were assumed to be prominent in the medical centre.

5.3 Interviewees' perceptions of the e-appointment service

5.3.1 Perceived advantages of the EAS

Twelve out of fourteen interviewees (86%) who used the e-appointment system at least once stated that the service was easy to use. In comparison with the phone-call based system, the e-appointment service provided certain advantages such as after-hour access to the medical appointment service and less waiting time.

5.3.1.1 Less waiting time

Eleven out of fourteen interviewees (79%) who used the e-appointment service at least once agreed that they could schedule an appointment as soon as they needed it. One patient said:

"The online system gives your available time slots, or just straightway what's available and what's not." [Patient 15]

5.3.1.2 Providing after-hour service

With the phone call-based appointment service, after-hour appointment requests were diverted to a message recorder in the medical centre, and the patient was advised to call back during office hours. Therefore the e-appointment system provided patients with the opportunity for "self-service" available 24 hours a day and 7 days a week. From January 2011 to May 2013, 4,415 appointments were made through the e-appointment service, 34.5% (N = 1,521) of them were made after hours, and the remaining 65.5% (N = 2,894) were made during the period of 8am to 7pm, which were the business hours of the medical centre. Of those after-hour online appointment requests, 54% (N = 820) were lodged during the period of 11pm to 7am, and another 46% (N = 701) were made during the period of 8pm to 11pm. The percentage of online appointments made during business hours and after-hours are presented in Figure 5.1. It can be seen that, in each year, more than 60% of the online appointments were made during business hours, 18-21% were made during the period of 12am to 7am, and 15-17% of online appointments were made between 8pm and 11pm.

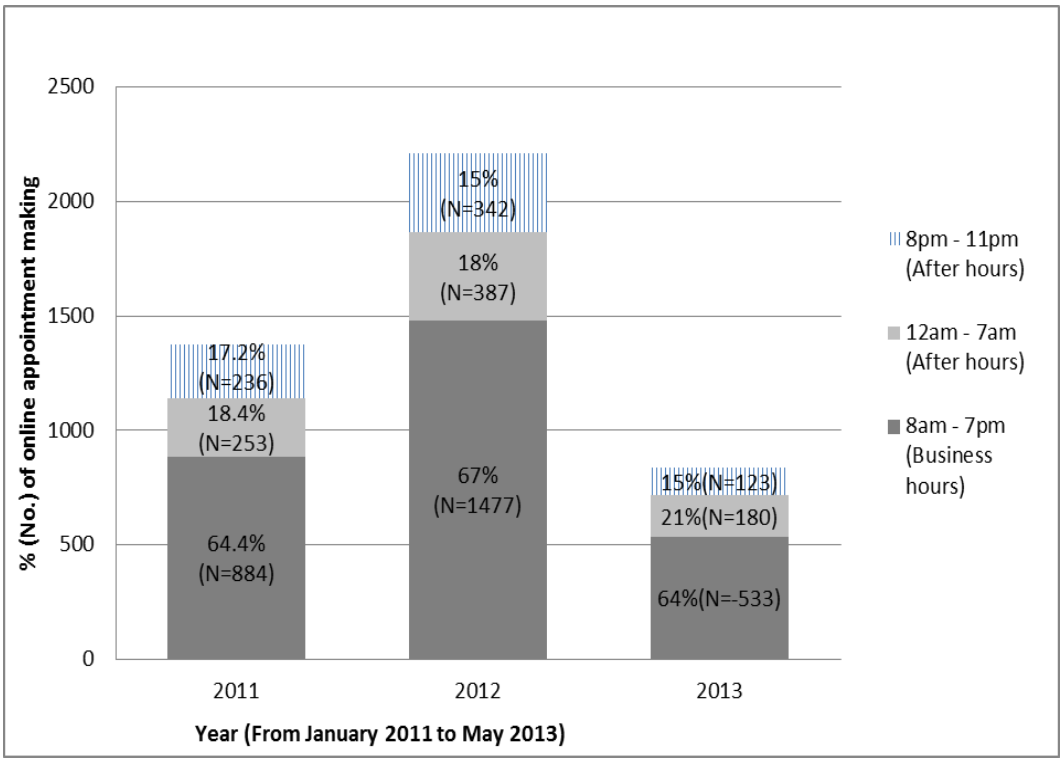

Figure 5.1 Usage of the e-appointment service by patients during each period (2011 and 2012: January to December, 2013: January to May)

5.3.2 Perceived disadvantages of the e-appointment system

The interview data suggests that inflexible time slot allocation and an insufficient number of appointment selection options were the main disadvantages of the e-appointment system as perceived by the interviewees.

5.3.2.1 Inflexible time slot allocation

Inflexible time slot allocation was reported to be the major disadvantage of the e-appointment system. Five out of fourteen interviewees (36%) who used the online service at least once recommended that the time slot allocation should be more specific. For example, one interviewee suggested that:

"The appointment times are very limited. It seems there is only one appointment time for the online customer which is always 12 minutes past the hour. A few more choices would be helpful." [Patient 43]

Where a patient's initial preference could not be met, the patient was required to choose a different date, time or doctor. Four interviewees suggested that the service should support "find doctors who meet desired time and date" or "display all available time slots for a specific doctor", as one interviewee said:

"Very good that you don't have to ring up, but we should be able to see what doctors are available at the time you pick instead of having to go back if it's not the right time for you." [Patient 27]

5.3.2.2 Insufficient selection options

Insufficient options provided by the e-appointment system for appointment making

Four out of fourteen interviewees (29%) who used the e-appointment service at least once suggested that this service should provide management options for making online appointments. One interviewee said:

"[The online service] doesn't allow you to cancel the appointment. It would be helpful as I cannot always get to the phone easily." [Patient 65]

Similarly, another interviewee suggested that

"[To add] the ability to manage your booking would be nice, just in case you need to cancel an appointment or change the time." [Patient 19]

5.4 Patients' prior experience of using online health services

Among all interviewees, the youngest age group (18-29 years) used the Internet the most for health-related purposes (54%, N = 19). Use of the Internet for health-related purposes appeared to decrease with increasing age. Those aged above 65 years had the lowest rate of Internet usage (15%, N = 2), as shown in Table 5.9.

Table 5.9 Percentage of interviewees who reported to have or not to have had prior experience with online healthcare services

		% (No.) of interviewees	
		Searched online health information	**Using e-appointment service at least once**
Age	18-29	54% (19/35)	14% (5/35)
	30-41	50% (16/32)	19 % (6/32)
	42-53	41% (11/27)	11% (3/27)
	54-65	33% (6/18)	–
	Above 65	15% (2/13)	–
	Total	43% (54/125)	11% (14/125)

The interview data suggests that 76% (n = 41) of these online healthcare service users searched for general health-related information, such as information about the common flu, vaccinations, side effects of new medications and suggestions for healthy food. The remaining 24% (N = 13) had searched for disease information of concern to them, such as information about kidney-stents, cancer, symptoms of heart disease or mental health problems.

Although 43% of the interviewees had prior experience of using the Internet for health-related purposes, more than 50% of the interviewees reported their preference for obtaining information from their doctors rather than from searching the Internet. They believed doctors could provide more accurate and credible information than the Internet.

5.5 Interviewees' intention to use the e-appointment service in the near future

The percentage of interviewees who intended to use the EAS at each age group is given in Table 5.10. In total, 25.6% (N = 32) of respondents expressed their intention to use the online system next time to see a doctor.

Table 5.10 Percentage of interviewees who intended to use the e-appointment system

		Would like to use the online system in the near future % (N)	
		Male	**Female**
Age	18 - 29	31% (4)	42% (8)
	30 - 41	38% (5)	37% (7)
	42 – 53	23% (3)	16% (3)
	54 – 65	8% (1)	5% (1)
	Above 65	–	–
Total		100% (13)	100% (19)

The remaining 74% of respondents (N = 93) preferred to use the phone-call based service. They persisted in phone-call appointment making for the reasons set out in section 5.1.6.1 and following:

5.5.1 Phone-call service is better than online appointment making

Thirty interviewees reported that they perceived the phone-call as an easy, quick and convenient to access the appointment service in comparison with the e-appointment service. "Ease of use", "quick" and "convenient" were frequently mentioned in response to the questions in regard to the individuals' preference for appointment services; as one interviewee said:

"I prefer to use phone call, it's convenient and quick. You can talk to a real person". [Patient 103]

Similarly, another interviewee stated that:

"I'm happy to use the phone. It's easier to ring up and speak to a person" [Patient 26]

5.5.2 Low computer literacy or poor Internet skills

Twenty-three interviewees who persisted in phone-call appointment making reported that they never used the Internet for health-related purposes because of low computer

literacy or Internet skill. From their perspective, the online appointment making was more complex than the phone-call service. For example, one interviewee stated that *"Because I don't use the Internet for the appointment, I probably don't really know what's available anyway... I probably use the phone. I find it is easier (to use the phone)." [Patient 38]*

5.5.3 Lack of access to the Internet at home

About 30% of the interviewees (N = 28) who preferred to use the phone-call appointment service reported that they did not have a computer or Internet connection at home, therefore phone-call or walk-in appointment making was the only choice for them. Of these patients, 64.3% (N = 18) were unemployed and 21.4% (N = 6) worked full-time, respectively. The remaining 14.3% (N = 4) worked part-time. The relationship between work status and computer/Internet connection at home was examined by Spearman's correlation analysis. A significant association was found between employment status and Internet access at home (r_s (123) = 0.462, p = .006) (see Table 5.11). It implies that patients who were not in the labour force were less likely to have an Internet connection at home than those who worked full-time or part-time.

Table 5.11 Spearman correlation and Chi-Square tests on Internet access at home and employment status

	Access the Internet at home	**Cannot access the Internet at home**	**Total**
Full time	32	33	65
Part time	15	11	26
Unemployment	7	27	34
Total	54	71	125
Spearman correlation value = .462			
Pearson Chi-Square value = 10.273			

Asymp.Sig.(2-sided) = .006

5.5.4 Preference for oral communication

Twelve interviewees who preferred phone-call appointment making reported that, in comparison with an e-appointment service, the phone call service provided them with more opportunity to discuss the options for more complex situations. The convenience, flexibility and effectiveness in negotiation and problem solving through oral communication were the frequently mentioned reasons. For example, one interviewee said:

"I would prefer to use the phone because I prefer to speak to someone and confirm. I would rather to trust the person than trust the computer" [Patient 117]

5.6 Variations in patients' continuous usage of the e-appointment system over two and a half years

In order to examine if patients' perceptions of the e-appointment system changed over time, the computer log data that reflects the continued usage of two modes of appointment making: phone-call/walk-in versus e-appointment service, was collected and compared in the running chart across the entire study period (see Figure 5.2). The top line shows the monthly number of visiting patients who used phone-call/walk-in services to make appointments to see their doctors. It can be seen that the number of phone-call/walk-in patients per month had gradually increased from 3,906 to 6,897 patients over two and a half years, and the average number was 5,367 patients per month (SD 832 and CI 95% = 5,064 – 5,670). The flat line at the bottom of the Figure shows the monthly number of patients who used the e-appointment system at least once. The average number was 128 patients per month (SD 49 and CI 95% = 110 - 146). It can be seen that the number of patients using the online self-

service remained unchanged, even slightly reduced in 2013. This is because the online system had been shut down several times for server maintenance.

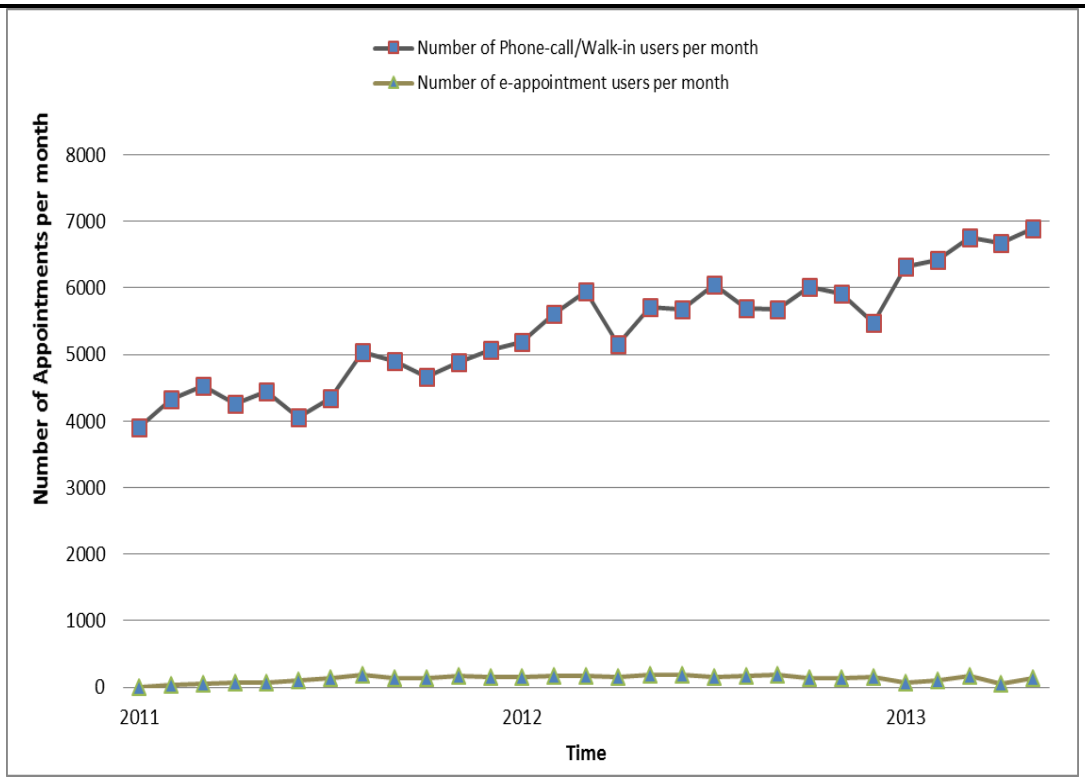

Figure 5.2 Overall usage of phone-call/walk-in and online appointment services from January 2011 to May 2013

In order to investigate patient usage patterns, online appointment users were further split into four categories (see Figure 5.3): (1) ONL1: logged into the medical centre web site but never used the online appointment service. On average, there were 321 patients per month (SD 80 and CI 95% = 292 - 350) in this group; (2) ONL2: used the online appointment system only once and continued making appointments by phone-call appointment thereafter. The average number was 44 patients per month (SD 18 and CI 95% = 38 - 50); (3) ONL3: used the online appointment system more than once, but also used the phone call-based system. The average number was 14 patients per month (SD 7 and CI 95% = 11 - 17); and (4) ONL4: always used the

online appointment system. The average number was 69 patients per month (SD 29 and CI 95% = 59 - 79).

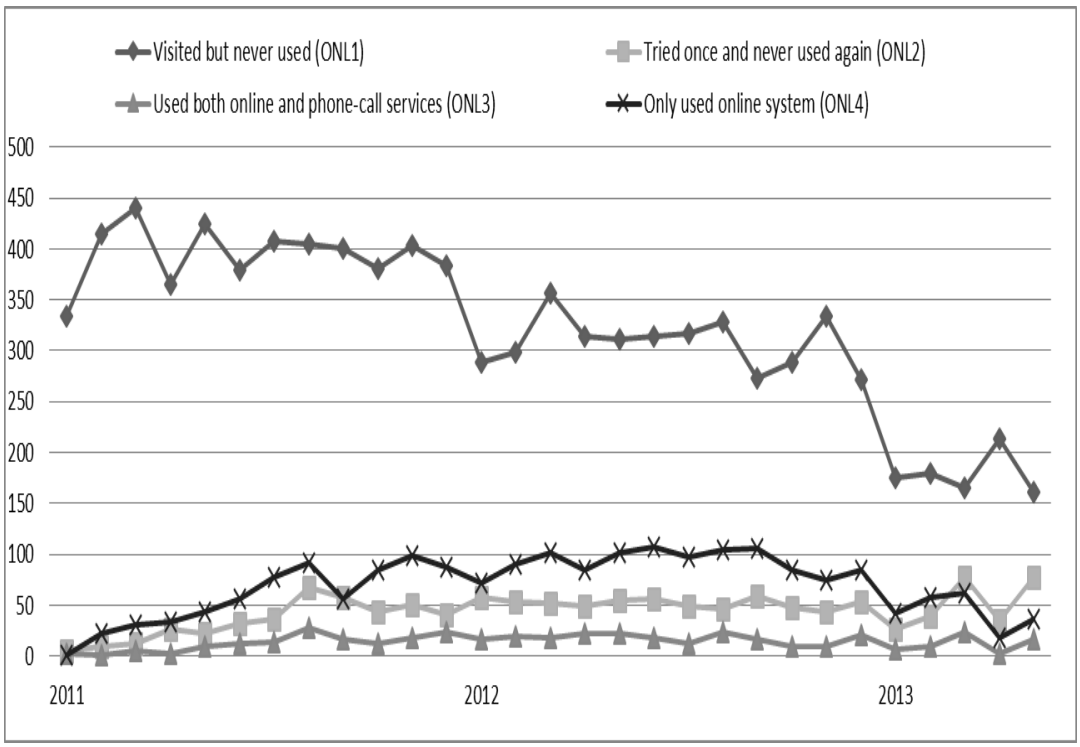

Figure 5.3 Overall usage trend of the online appointment service by registered users over twenty-nine months of field study (from January 2011 to May 2013).

The detailed number of each type of user is given in Table 5.10. It can be seen that at the first data point (from January to December 2011), 5,978 patients logged into the online appointment web site. Among these online users, more than 79% (N = 4,737) persisted in phone-call/walk-in appointment making, and 6.8% (N = 407) used the online appointment service only once and never used it again. Among the remaining 14% of online users (N = 834), 18% (N = 147) used both the online service and phone-call/walk-in for appointment making, and 82% (N = 687) used the online system only for making an appointment.

At the second data point (from January to December 2012), 5,642 patients logged into the online appointment web site (see Table 5.12). In comparison with the first data point, the number of patients who preferred to use the online service (in category ONL3 and ONL4) had significantly increased to 1,322, accounting for 23% of the total online users. The number of patients in each category remained similar at the third data point (from January to May 2013).

Table 5.12 Categories of online system users recorded in the computer log records at each data point (from January 2011 to May 2013)

	% (No.) registered patients at each data point in computer records		
Usages of online appointment system by registered users	**January to December 2011 % (N)**	**January to December 2012 % (N)**	**January to May 2013 % (N)**
1. Logged into web site but never used	79.2% (4737)	65% (3696)	63% (895)
2. Tried once and never used again	6.8% (407)	11% (624)	18% (256)
3. Used both online and phone-call services	2.5% (147)	4% (212)	4% (60)
4. Only used online system	11.5% (687)	20% (1110)	15% (217)
Total	100% (5978)	100% (5642)	100% (1428)

5.7 Summary of the Chapter

This chapter provides detailed results of qualitative and quantitative data analysis of patient acceptance and usage of the e-appointment system. The qualitative data

gathered from 125 interviewees were coded and examined in regard to the four elements mentioned in the Rogers' Innovation Theory, including communication channels, the attributes of the innovations, the characteristics of the adopters and the social system. In addition, computer log records were collected in order to examine patients' ongoing usage of the e-appointment service. The findings show that the users of the e-appointment system were those patients who visited the CHC web site and only 11% of the interviewed patients belonged to this group. Less waiting time and providing after-hour service were the main reasons for patient's intention to use this online service. However, the majority interviewed patients expressed reluctance to adopt this service because of a lack of access to the Internet, incompatibility with the majority of people's habit of medical appointment making or they were not used to the Internet-based health service delivery. The discussion and implications of the findings for both theory and practice are provided in Chapter 6.

CHAPTER SIX. GENERAL DISCUSSION AND CONCLUSIONS

As described in the Introduction (Chapter. 1) and Literature Review (Chapter. 2) chapters, consumer e-Health may provide tremendous opportunities for improving health care services and reducing costs. However, as this innovative service model is in the initial introductory stage, its practicality and benefits are yet to be validated in practice. It still remains unclear if patients are willing and able to accept and use this rapidly developing technology. Therefore, this study aims to investigate the factors influencing patient acceptance and usage of a consumer e-Health innovation in primary health care in Australia. A socio-technical approach was employed for the identification of the information needs in a specific primary health care clinic – Centre Health Complex (CHC) – in a regional town Shellharbour in Australia. This led to the identification of a specific consumer e-Health system that need to be introduced into the clinic – an e-appointment scheduling system.

In this final chapter, a discussion of the major findings of the patient acceptance and usage of the system over 29 months is presented at first. This is followed by a description of answers to the research question. The research limitations, implications to the further research and practice are specified and finally, some issues that could be further investigated in future studies of consumer acceptance of e-Health services are suggested.

6.1 Discussion of the Major Findings of the Patient Acceptance and Use of the E-Appointment System

As discussed in Chapter 3, a review of the research literature in the topic area leads to the proposal of the following five research propositions:

P1: Patients are not adopting consumer e-Health service because they are not aware of the availability of the service or benefits it offers.

P2: Patients are not adopting consumer e-Health service because they do not find that it is useful or easy to use.

P3: Patients are not adopting consumer e-Health service because they do not have convenient access to the computer/Internet.

P4: Patients are not adopting consumer e-Health service because they do not want to change from currently familiar ways of operating.

P5: Patients are not adopting consumer e-Health service because they do not have previous experience of using health-related online services.

To test the above propositions, an extensive qualitative and quantitative study was conducted. Data was collected and analyzed in order to understand patient acceptance and use of the e-appointment system.

The study results show that the e-appointment system is still in the early implementation stage and its adoption was slow, with growth slow and marginal. The computer log records show that the monthly adoption rate of the e-appointment system increased slowly from 1.5% (76/4,941 patients/month) at three-months after system implementation, to 4% (287/7,189 patients/month) at twenty-nine months. The monthly number of patients using the e-appointment system was steady, compared to the increasing number of patients who used phone-call/walk-in appointment services at the end of study period (see Chapter 5 Figure 5.2). Computer log records also show that, although more than 300 patients visited the online appointment web site each month, most of them were still not ready to accept this e-health innovation. In total, only 6% (1,554/25,616) of patients continuously used the e-appointment service to see the doctors in the clinic during the whole period of the

study. The overall adoption rate of the e-appointment system was still lower than the 'take-off' point – 13% of the overall population according to Rogers' Innovation Diffusion Theory [34]. Therefore, at the end of the study, only the 'innovators' had adopted the online service.

As suggested by Rogers [132], the communication channels, the attributes of the e-appointment service, the characteristics of the patients who were the consumers of the online system, and the social system, had all contributed to the low adoption rate of the online service. The following sections discuss the main findings of the study according to Rogers' Diffusion of Innovation theory and the research propositions.

6.1.1 Influence of communication channels on patient adoption of the e-appointment system

In this study, the information about the availability of the e-appointment service was carefully planned and disseminated to patients through mass media channels, including posters, fliers and web advertisement. However, twenty-nine months after system implementation, only 5% of appointments were made through the e-appointment system. The majority of patients were not aware of the existence of the online service and consequently, could not use it for appointment making.

In response, a new communication channel – a voice message played during the phone call waiting periods was implemented 6 months after implementation. This appeared to be an effective channel that helped to increase patient awareness of the online appointment service to a certain extent, as suggested by the 55% of the interviewees who reported that they were aware of the existence of the online appointment system at the second data point. However, twenty-nine months after system implementation, despite the introduction of the voice message, only 23% of the interviewees reported being aware of the availability of the online system. It

appears that the majority of patients did not pay attention to the voice-message, which can be seen as an example of mass media in Rogers' terms [132]. Hence, the finding led to the support of the first research proposition:

P1: Patients are not adopting consumer e-Health services due to a lack of awareness of such a service and its benefits.

The interview results suggest that the use of mass media was not effective in attracting patients' attention to the availability of the e-appointment service. Obviously, lack of awareness of the existence, features and benefits of the e-appointment service had a negative impact on patient adoption of the new e-health system, as validated by the result of the correlation between the interviewees' awareness and usage of the e-appointment service. This fact confirms the view of Cao et al. (2011) that effective dissemination of information about any new online technology could improve usage of the innovation [166]. This lesson is useful to learn for other consumer e-health initiatives, so that more effective and personalized communication strategies can be developed and used to increase patient awareness of a new e-health service.

6.1.2 Influence of the perceived attributes of the e-appointment system on its adoption and use

According to Rogers (1995), there are four perceived attributes of the e-appointment system which might influence patient adoption and use of the service. They are relative advantages, compatibility, complexity and trialability.

6.1.2.1 Relative advantages

The interview results show that the extended after-hour service and less waiting time appeared to be the main attributes attracting patients to adopt the e-appointment service.

However, more than 88% (N = 111) of the interviewees expressed their preference for using the phone call appointment service. From their perspective, the e-appointment service was inferior to making an appointment by phone. This was because the phone-call service provided them with an immediate, fast and convenient way to access the appointment service compared with the e-appointment system. In addition, the phone-call service provided an opportunity for patients to chat with a person – the receptionist – who could make a more flexible decision on the spot. They saw no personal advantages in making appointments online. Lee et al. also suggested that patients' need for human interaction may hinder their adoption of online self-service [150].

Furthermore, the e-appointment service did not provide patients with any other value-adding services, such as access to patient electronic healthcare records. Therefore, there was little or no value for patients to switch to the e-appointment service. The above finding led to the support of the second proposition:

P2: Patients are not adopting consumer e-Health service because the service is not perceived to be useful or easy to use.

6.1.2.2 Complexity

Although the e-appointment service was perceived as easy to use for those patients who had continued to use this service, a large number of patients in this study had never accessed the Internet at home. Some did not even have a computer or Internet

access at home. As a result, more than 74% of the interviewees (N = 93) did not feel confident about their ability to use the Internet or the e-appointment service. The above finding led to the support of third proposition:

P3: Patients are not adopting consumer e-Health service because of the non-availability of the convenient access to the computer/Internet.

6.1.2.3 Compatibility

A major reason for patients to continue with making appointments by phone was its compatibility with their preference of having a conversation with a person, the opportunity to discuss the options for more complex situations and to receive reliable information from their doctors. Therefore, tradition and habit appeared to play an important role in hindering adoption of the e-appointment system. To our knowledge, it is the first time that this factor has been reported in the studies on the adoption of consumer e-health innovations [242]. It might help to increase the probability of patient adoption of the e-appointment system if the system can integrate a voice message similar to the receptionist talking to patients addressing their real-time concerns. This led to the support of the fourth proposition:

P4: Patients are not adopting consumer e-Health service because of their resistance to change from currently ways of operating.

6.1.2.4 Trialability

In this study, the computer log records showed that 45% of the registered users stopped using the system after a trial use. There might be several explanations for this: (1) the patient did not need to see the doctor again after the appointment; or (2) they directly made the follow-up appointment after seeing a GP in the clinic and thus had no further need to make appointments online; or (3) they preferred to make

appointments by phone or in person rather than using the e-appointment service. Karahanna et al. (1999) also indicate that trialability appears to be a less important factor in determining an individual's decision to continuously use an IT innovation after the individual has adopted the innovation [171].

6.1.3 Influence of patient characteristics on adoption of the e-appointment system

In this study, the patients' social and demographic characteristics, including age, education level and work status, appeared to have influenced their choice of use or non-use of the e-appointment service. Computer log records showed that 72% of the 'innovators' (N = 1116) were in the age group of 18 to 41 years.

The reason why the patient group who worked full-time were more likely to use the e-appointment service might be that this group had difficulty making phone calls during office hours, and could only do so after-hours. In this case, the online service might be helpful. Thirty six percent of the online appointment users (N = 5) had a university degree, suggesting that the younger patients with a higher educational level and better job prospects are more likely to adopt consumer e-health services than older, less educated patients with fewer job opportunities.

In addition to the social and demographics factors, all of the patients who reported using the e-appointment service had prior experience using the Internet for health-related purposes, as shown in Chapter 5 Table 5.9. LaRose and Eastin found that users' Internet self-efficacy is positively affected by their prior Internet experience, positive outcome, and Internet usage [243]. Macpherson et al. (2014) also reported that low computer/Internet skill levels could have a negative impact on the acceptance and use of e-Health services by older adults [77]. Therefore, having prior experience of using online health care services also appears to be positively

associated with patient acceptance of the e-appointment service. Consequently, the finding led to the support of the last proposition:

P5: Patients are not adopting consumer e-Health service because of the lack of prior experience of using health-related online services.

6.1.4 Influence of the nature of the social system on the adoption of the e-appointment system

According to the Australia Bureau of Statistics' 2011 census data, the population of the study site had a lower income and higher un-employment profile in comparison with the national demographic data [198]. The interview results suggest that this population group is yet to develop the capacity and interest in using the Internet for health-related purposes. As explained by Rogers' Innovation Diffusion Theory, the probability of patients adopting the e-appointment service was negatively influenced by their lower socio-economic profile.

6.2 Factors Influencing Patients' Acceptance and Use of Consumer e-Health Service

6.2.1 Factors influencing patients' adoption of consumer e-Health service

As discussed in the previous sections, this study found that the adoption and usage of the a-appointment system in CHC has been low after the system was introduced for 29 months. The findings of the study suggest that several factors appeared to influence patient's adoption of consumer e-Health innovation: awareness, perceived advantages, accessibility, compatibility and previous experience of using online health services. The impact of each factor on patients' acceptance of consumer e-Health innovation is listed below:

- Awareness: According to Rogers (1995), the adoption and rejection of an innovation begins when "the consumer becomes aware of the product" [132].

In this study, the survey results show that majority of the patients remained unaware of the existence of the e-appointment service and consequently, could not use it for appointment making over the entire survey period. This results suggest that lack of awareness of the existence, features and benefits of the online system appears to have a negative impact on the patients' acceptance of the consumer e-Health service. This finding agrees with Lee's argument that lack of awareness of the outcomes of the system decreased user's acceptance of HIS systems [143].

- Perceived advantages: According to Moore and Benbasat (1991), technological innovations must be perceived to be usefulness and easy to use to ensure consumer acceptance [137]. The study results show that most of the interviewees preferred to use phone-call appointment service rather than online appointment making. From their perspective, the relative advantages of the e-appointment system was insignificant, or there were no personal advantages in making appointment online. Therefore, a perceived lack of advantages appears to be the factor causing the low adoption of consumer e-Health innovations.
- Accessibility: According to Culnan (1984), the availability of access to computers/ the Internet is a prerequisite for consumer adoption of online services [168]. The study results show that a large number of patients did not have the habit of accessing the Internet at home, and some did not even have computer or Internet access at home during the time of field study. As a result, the low level of accessibility to the computer/ Internet at home appears to have a negative impact on the patients' adoption of the e-appointment system.

- Compatibility: The study results show that the e-appointment was perceived to be incompatible with the majority of patients' preference for oral communication with their doctors or receptionists. As a result, most of patients continued in phone-call appointment making. The finding reveals that the compatibility is an important factor that influence patients' acceptance of consumer e-Health innovations, as reported by Chau and Hu (2001) [174].
- Previous experience of using online health services: The study results shows that more than 57% of interviewees reported their lack of previous experience of online health services usage had led to non-adoption of the online appointment system. By contrast, patients who reported using the e-appointment system generally expressed confidence in their ability to use the Internet for health-related purposes. Therefore, an individual's Internet literacy or previous experience with the online health services affects the decision of whether or not to adopt consumer e-Health innovations.

6.2.2 Factors influencing patients' continued or discontinued use of consumer e-Health service

- Perceived relative advantages and demographic variables: In this study, the interview results suggest that the e-appointment system was perceived to be advantageous for those patients who worked full-time and could only make an appointment to see a doctor after business hours. In addition, the computer log data shows that this e-Health service is still in the initial knowledge stage of the innovation-decision process, and only the 'innovators' in the patient population adopt and continuously used this innovation by the end of the field

study, this finding agree with Lee's argument that consumer demographics influence their online service usage intentions through the mediating effects of technology innovativeness [150]. Therefore, perceived relative advantages of the innovation and demographic variables, including age, education level and work status, appeared to have influenced patients' choice of use or non-use of the e-appointment service.

6.3 Limitation of the Study

The research was conducted in a regional area in Australia, therefore the findings may only be comparable to a similar population group. Qualitative studies in other suburban areas would enrich and extend our understanding about patients' adoption of consumer e-health innovations.

Although a socio-technical approach was adopted in the design and development of the system. The social actors to be engaged in the requirements capture process were limited to the practice managers and receptionists. The major users of the e-appointment system, patients, were not engaged in the requirement capture process. This caused a lack of understanding of the intention of the patients towards consumer e-Health application, and the lack of adoption of the developed system afterwards. This lesson should be learned. Any future initiative in developing consumer e-Health applications needs to involve consumer upfront, instead of only engaging them as the end users after the system is fully implemented.

Although it would be advantage to address the research questions by quantitative study. The challenges of enrolling patients into questionnaire survey prohibited the usage of quantitative questionnaire survey method. To effectively engage patients into the study, the method of researcher directly interviewing patients were used to

acquire patients' perceptions of the e-appointment system. Although this is labour intensive, it reached almost 100% response rate.

Another limitation in sampling is that the patients who were sitting in the waiting area and appeared to be willing to communicate with researchers were more likely to be invited to participate in the interview. This selection bias was revealed by a much higher adoption rate of 13% revealed by the interview results than the 6% of population consistently suggested by the computer log records. The bias in the interview results was effectively rectified by the computer log records. In addition, this study was conducted based on a particular form of consumer e-health application – the online appointment service. Therefore caution is needed in generalizing the relevance of the findings from this study to other types of consumer e-health applications in similar or other healthcare settings. Further substantial studies are needed to understand patient behavior in adopting more complicated consumer e-health innovations.

6.4 Implications and Suggestions for Future Research

This study provides valuable insight about the feasibility of introducing consumer e-health services in a primary health care setting. Knowledge of factors influencing patients' attitude towards acceptance and intention to use consumer e-Health services can help health care providers and researchers to design, develop and offer better consumer e-Health services to match patients' needs.

The findings of this study were in accordance with Rogers' four determinants of success of innovations [132]. Communication of the new e-health initiative to patients appears to be difficult. As identified in Chapter 2 and 5, lack of awareness about the availability and benefits of consumer e-Health stand out as the obstacles to

the adoption of this innovative health care service. The survey results show that many patients were simply not aware of the existence of this new service. This challenge cannot be underestimated for any similar e-health initiatives. The results suggest that gaining consumer attention is influential in the adoption of the innovative consumer e-Health service and this must be achieved before any other factors are considered. In response to the findings of the study, the following suggestions are recommended to health care providers who plan to introduce consumer e-Health services in the future:

- Health care providers should mobilize all available communication channels, even creating new channels to communicate the availability and benefits of consumer e-Health services to patients, such as demonstration kiosks at the supermarkets or public libraries, where people can obtain direct experience of using consumer e-Health.
- Lack of access to the Internet is a major barrier for older patients and those with little Internet experience to adopt and use consumer e-Health services. Although the Internet coverage and usage rate in Australia is high, not everyone has the opportunity to go online from home or work. Therefore, any government or private initiatives in introducing consumer e-Health services need to provide alternative service options to accommodate this population group's capability to access to the service.
- Resistance to change is another barrier to the adoption of consumer e-Health services. Changing patients' habits is a long-term effort. Health care providers need to design and implement more effective strategies to convince patients that using e-Health services is not incompatible with their way of doing things.

The findings point to a need for health care providers to consider and address the identified factors before implementation of more complicated consumer e-health services, such as myHealth Record in Australia. This study also suggests that Rogers' innovation theory is adequate and applicable in the context of the study of patients' adoption of e-Health innovations.

Further researches can be conducted on other types of consumer e-health services and the optimal implementation strategies that could lead to realization of successful adoption, usage and benefits.

REFERENCES

[1] Armstrong, B.K., Gillespie, J.A., Leeder, S.R., Rubin, G.L., Russell, L.M., Challenges in health and health care for Australia, *The Medical Journal of Australia* 2007, 187(9): 485-489.

[2] Eysenbach, G., Recent advances: Consumer health informatics, *Birtish Medical Journal* 2000, 320(7251): 1713-1716.

[3] Houston, T.K., Ehrenberger, H.E., The potential of consumer health informatics, *Seminars in Oncology Nursing* 2001, 17(1): 41-47.

[4] Keselman, A., Logan, R., Smith, C.A., Leroy, G., Zeng-Treitler, Q., Developing Informatics Tools and Strategies for Consumer-centered Health Communication, *Journal of the American Medical Informatics Association* 2008, 15(4): 473-483.

[5] Brennan, P.F., Patient-Focused Technology and the Health Care Delivery System, in: David H. Gustafson, Patricia Flatley Brennan, r.P. Hawkins (Eds.) Investing in E-Health: What is Takes to Sustain Consumer Health Informatics, Springer Science Business Media, New York, 2007, pp. 1-6.

[6] Carty, B., Kenney, K., Consumer informatics in primary care, *Stud Health Technol Inform* 2006, 122: 36-37.

[7] Deluca, J.M., Enmark, R., E-Health: the changing model of healthcare, *Fronttiers of Health Services Management* 2000, 17(1): 3-15.

[8] Kwankam, S.Y., What e-Health can offer, *Bull World Health Organ* 2004, 82(10): 800-802.

[9] Cashen, M.S., Dykes, P., Gerber, B., eHealth technology and Internet resources: barriers for vulnerable populations, *Journal of Cardiovascular Nursing* 2004, 19(3): 209-216.

[10] Eysenbach, G., Diepgen, T.L., The role of e-Health and consumer health informatics for evidence-based patient choice in the 21st century, *Clin Dermatol* 2001, 19(1): 11-17.

[11] Marconi, J., E-Health: Navigating the Internet for health Information Healthcare. Advocacy White Paper, in: *H.I.a.M.s. Society* (Ed.) Secondary "E-Health: Navigating the Internet for health Information Healthcare. Advocacy White Paper", 2002.

[12] Eysenbach, G., What is e-health, *J Med Internet Res 2001* 2001, 3(2): 20.

[13] Eysenbach, G., Recent advances Consumer health informatics, *Birtish Medical Journal* 2000, 320(7251): 1713-1716.

[14] Calabretta, N., Consumer-driven, patient-centered health care in the age of electronic information, *J Med Libr Assoc* 2002, 90(1): 32-37.

[15] Bergeson, S.C., Dean, J.D., A Systems Approach to Patient-Centered Care, *JAMA* 2006, 296(23): 2848-2851.

[16] Stewart, M., Brown, J.B., Donner, A., McWhinney, I.R., Oates, J., Weston, W.W., Jordan, J., The Impact of Patient-Centered Care on Outcomes, *The Journal of Family Practice* 2000, 49(9): 796-804.

[17] Klein-Fedyshin, M.S., Consumer Health Informatics-Integrating Patients, Providers, and Professionals Online, *Medical reeference Services Quarterly* 2002, 21(35-50).

[18] Mukherjee, A., McGinnis, J., E-healthcare: an analysis of key themes in research, *International Journal of Pharmaceutical and Healthcare Marketing* 2007, 1(4): 349-363.

[19] Hordern, A., Andrew, G., Sue, W., Mirela, P., Consumer e-health: an overview of research evidence and implications for future policy, *Health Information Management Journal* 2011, 40(2): 6-14.

[20] Austin, C., Boxerman, S., Information Systems For Healthcare Management (7th ed), 7 ed., Health Administration Press/AUPHA, Chicago, 2008.

[21] Nicholas, D., Huntington, P., Williams, P., Gunter, B., First steps towards providing the UK with health care information and advice via their television sets: an evaluation of four Department of Health sponsored pilot services, *Aslib Proceedings* 2003, 55(3): 138-154.

[22] Baldwin, L.P., Clarke, M., Eldabi, T., Jones, R.W., Telemedicine and its role in improving communication in healthcare, *Logistics Information Management* 2002, 15(4): 309-319.

[23] Kassirer, J.P., Patients, physicians, and the Internet, *Health Affairs* 2000, 19(6): 115-123.

[24] González, M.E., Quesada, G., Urrutia, I., Gavidia, J.V., Conceptual design of an e-health strategy for the Spanish health care system, *International Journal of Health Care Quality Assurance* 2006, 19(2): 146-157.

[25] Bauer, K.A., Using the Internet to empower patients and to develop partnerships with clinicians, *World Hosp Health Serv* 2002, 38(2): 2-10.

[26] Yu, P., Courten, M.D., Pan, E., Galea, G., Pryor, J., The development and evaluation of a PDA-based method for public health surveillance data collection in developing countries, *International Journal of Medical Informatics* 2009, 78(8): 532-542.

[27] Pancoast, P.E., Patrick, T.B., Mitchell, J.A., Physician PDA Use and the HIPAA Privacy Rule, *J Am Med Inform Assoc.* 2003, 10(6): 611-612.

[28] Lindquist, A.M., Johansson, P.E., Petersson, G.I., Saveman, B.-I., Nilsson, G.C., The Use of the Personal Digital Assistant (PDA) Among Personnel and Students in Health Care: A Review, *J Med Internet Res* 2008, 10(4).

[29] Burton, C., Weller, D., Sharpe, M., Are electronic diaries useful for symptoms research? A systematic review, *Journal of Psychosomatic Research* 2007, 62(5): 553-561.

[30] Can the ubiquitous power of mobile phones be used to improve healthBlaya, J.A., Fraser, H.S.F., Holt, B., E-Health Technologies Show Promise In Developing Countries, *Health Affairs* 2010, 29(2): 244-251.

[31] Kaplan, W.A., Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries?, *Global Health* 2006, 2(9).

[32] Martinez, A.W., Phillips, S.T., Carrilho, E., Thomas, S.W., Sindi, H., Whitesides, G.M., Simple Telemedicine for Developing Regions: Camera Phones and Paper-Based Microfluidic Devices for Real-Time, Off-Site Diagnosis, *Analytical Chemistry* 2008, 80(10): 3699-3707.

[33] Phillips, G., Felix, L., Galli, L., Patel, V., Edwards, P., The effectiveness of M-health technologies for improving health and health services: a systematic review protocol, *BMC research notes* 2010, 3(250).

[34] World Health Organization, mHealth: New Horizons for Health Through Mobile Technologies, Secondary "mHealth: New Horizons for Health Through Mobile Technologies", World Health Organization, Switzerland, 2011.

[35] Franko, O.I., Tirrell, T.F., Smartphone App Use Among Medical Providers in ACGME Training Programs, *Journal of Medical Systems* 2012, 36(5): 3135-3139.

[36] Noel, H.C., Vogel, D.C., Erdos, J.J., Cornwall, D., Levin, F., Home Telehealth Reduces Healthcare Costs, *Telemedicine Journal and e-Health* 2004, 10(2): 170-183.

[37] Terry, M., Medical Apps for Smartphones, *Telemedicine and e-Health* 2010, 16(1): 17-22.

[38] Mosa, A.S.M., Yoo, I., Sheets, L., A Systematic Review of Healthcare Applications for Smartphones, *BMC Medical Informatics and Decision Making* 2012, 12: 67-67.

[39] Fox, S., Duggan, M., Mobile Health 2012, Secondary "Mobile Health 2012", Pew Research Center's Internet & American Life Project, Washington, D.C., 2012.

[40] Wilson, E.V., Lankton, N.K., Modeling patients' acceptance of provider-delivered e-health, *Journal of the American Medical Informatics Association* 2004, 11(4): 241-248.

[41] Cline, R.J.W., Haynes, K.M., Consumer health information seeking on the Internet: the state of the art, *Health Education Research* 2001, 16(6): 671-692.

[42] Masys, D., Baker, D., Butros, A., Cowles, K.E., Giving patients access to their medical records via the internet: the PCASSO experience, *J Am Med Inform Assoc* 2002, 9(2): 181 - 191.

[43] NEHTA, Concept of Operations: Relating to the Introduction of a Personally Controlled Electronic Health Record System, in: *A.D.o.H.a. Ageing* (Ed.) Secondary "Concept of Operations: Relating to the Introduction of a Personally Controlled Electronic Health Record System", National E-Health Transition Authority Ltd, Canberra, 2011.

[44] Murphy, J., Patients to get new myHealth Record: $485m 'rescue' package to reboot Labor's e-health failures, Secondary "Patients to get new myHealth Record: $485m 'rescue' package to reboot Labor's e-health failures"The Department of Health, 2015.

[45] Australian Health Ministers' Conference, National E-Health Strategy, in: *The Department of Health* (Ed.) Secondary "National E-Health Strategy", Australian Health Ministers' Conference, Melbourne, 2008.

[46] Kerwin, K.E., The role of the Internet in improving healthcare quality, *J Healthc Manag* 2002, 47(4): 225-236.

[47] Mullner, R.M., Introduction: The Internet and Healthcare: Opportunities and Challenges, *Journal of Medical Systems* 2002, 26(6): 491-493.

[48] Appleby, C., Health care.com. Trustees may soon find themselves on the board of an Internet startup, *Trustee : the journal for hospital governing boards* 2000, 53(1): 18-22.

[49] Finkelstein, S.M., Speedie, S., Hoff, M., Demiris, G., Tele-homecare: telemedicine in home health care, Secondary "Tele-homecare: telemedicine in home health care", 1999, pp. 681 vol.682.

[50] Miller, E.A., Telemedicine and doctor–patient communication: a theoretical framework for evaluation, *Journal of Telemedicine and Telecare* 2002, 8(6): 311-318.

[51] Potts, H.W.W., Wyatt, J.C., Survey of Doctors' Experience of Patients Using the Internet, *J Med Internet Res* 2002, 4(1): e5.

[52] Duffy, M., Wimbush, E., Reece, J., Eadie, D., Net profits? Web site development and health improvement, *Health Education* 2003, 103(5): 278 - 285.

[53] Eysenbach, G., Powell, J., Kuss, O., Sa, E.R., Empirical studies assessing the quality of health information for consumers on the World Wide Web: A systematic review, *Journal of the American Medical Association* 2002, 287(20): 2691-2700.

[54] Weiner, S.J., Barnet, B., Cheng, T.L., Daaleman, T.P., Processes for Effective Communication in Primary Care, *Annals of Internal Medicine* 2005, 142(8): 709-714.

[55] Meyers, J., Deryk Van, B., Patrick, K., Greene, A., Personalizing medicine on the Web: E-health offers hospitals several strategies for success, *Health Forum Journal* 2002, 45(1): 22-26.

[56] Branger, P.J., van't Hooft, A., van der Wouden, J.C., Moorman, P.W., van Bemmel, J.H., Shared care for diabetes: supporting communication between primary and secondary care, *International Journal of Medical Informatics* 1999, 53(2–3): 133-142.

[57] Branger, P.J., Van der Wouden, J.C., Schudel, B.R., Electronic communication between providers of primary and secondary care, *Br.Med.J* 1992, 305: 1068-1070.

[58] Snyder, K.D., Paulson, P., McGrath, P., Improving processes in a small health-care network: A value-mapping case study, *Business Process Management Journal* 2005, 11(1).

[59] Toussaint, P.J., Verhoef, J., Vlieland, P.P.M.V., Zwetsloot-Schonk, J.H.M., The impact of ICT on communication in Healthcare, in: *M.Fieschi* (Ed.) Secondary "The impact of ICT on communication in Healthcare", Amsterdam: IOS press, 2004, pp. 988-991.

[60] Davies, G.P., Harris, M., Perkins, D., Roland, M., Williams, A., Larsen, K., McDonald, J., Coordination of Care Within Primary Health Care And Other Sectors: A Systematic Review, in: *Australia Primary Health Care Research Institute, UNSW Research Centre for Primary Health Care, C.a.E.A.t.U.o.N.S.W.i.A.W.t.U.o.M. (UK)* (Eds.) Secondary "Coordination of Care Within Primary Health Care And Other Sectors: A Systematic Review"Sydney, 2006, pp. 1-141.

[61] Harrison, J.P., Lee, A., The role of e-health in the changing health care environment, *Nursing Economic* 2006, 24(6): 283-289.

[62] Ruxwana, N.L., Herselman, M.E., Conradie, D.P., ICT applications as e-health solutions in rural healthcare in the Eastern Cape Province of South Africa, *Health Information Management Journal* 2010, 39(1): 17-26.

[63] Hsu, J., Huang, J., Kinsman, J., Fireman, B., Miller, R., Selby, J., Ortiz, E., Use of e-Health Services between 1999 and 2002: A Growing Digital Divide, *Journal of the American Medical Informatics Association : JAMIA* 2005, 12(2): 164-171.

[64] Rudolph, M., Barr, M.S., Kuhn, T., Hersh, W.R., McDonald, C.J., Badlani, S., Overhage, J.M., Basch, P., Sands, D.Z., Bates, D.W., Walker, J.M., Corley, S.T., Zaroukian, M., Friedman, J.P., E- HEALTH AND ITS IMPACT ON MEDICAL PRACTICE, Secondary "E- HEALTH AND ITS IMPACT ON MEDICAL PRACTICE", American College of Physicians,, 2008.

[65] Lanseng, E.J., Andreassen, T.W., Electronic healthcare: a study of people's readiness and attitude toward performing self-diagnosis, *Journal of Service Management* 2007, 18(4): 394 - 417.

[66] Kluge, E.-H.W., e-Health promises and challenges: some ethical considerations, Secondary "e-Health promises and challenges: some ethical considerations", 2011, pp. 148-153.

[67] Kreps, G.L., Neuhauser, L., New directions in eHealth communication: Opportunities and challenges, *Patient Education and Counseling* 2010, 78(3): 329-336.

[68] Wilson, E.V., Balkan, S., Lankton, N.K., Current Trends in Patients' Adoption of Advanced E-Health Services, in: *B. Sule, K.L. Nancy* (Eds.) Secondary "Current Trends in Patients' Adoption of Advanced E-Health Services", IEEE Computer Society, Hawaii, 2010, pp. 1-9.

[69] Bitner, M.J., Brown, S.W., Meuter, M.L., Technology Infusion in Service Encounters, *Journal of the Academy of Marketing Science* 2000, 28(1): 138-149.

[70] Rogers, A., Mead, N., More than technology and access: primary care patients' views on the use and non-use of health information in the Internet age, *Health & Social Care in the Community* 2004, 12(2): 102-110.

[71] Williams, P., Nicholas, D., Huntington, P., Non use of health information kiosks examined in an information needs context, *Health Information & Libraries Journal* 2003, 20(2): 95-103.

[72] Jimison, H., Gorman, P., Woods, S., Nygren, P., Walker, M., Norris, S., Hersh, W., Barriers and Drivers of Health Information Technology Use for the Elderly, Chronically III, and Underserved, Rockville (MD): Agency for Healthcare Research and Quality (US), (US), 2008.

[73] Birru, M.S., Monaco, V.M., Charles, L., Drew, H., Njie, V., Bierria, T., Detlefsen, E., Steinman, R.A., Internet Usage by Low-Literacy Adults Seeking Health Information: An Observational Analysis, *Journal of Medical Internet Research* 2004, 6(3): e25.

[74] Or, C.K.L., Karsh, B.-T., A Systematic Review of Patient Acceptance of Consumer Health Information Technology, *Journal of the American Medical Informatics Association* 2009, 16(4): 550-560.

[75] Dohan, M.S., Tan, J., Perceived Usefulness and Behavioral Intention to Use Consumer-Oriented Web-Based Health Tools: A Meta-Analysis, Secondary "Perceived Usefulness and Behavioral Intention to Use Consumer-Oriented Web-Based Health Tools: A Meta-Analysis"Chicago, Illinois, 2013, pp. 15-17.

[76] Choi, N., Relationship between health service use and health information technology use among older adults: analysis of the US National Health Interview Survey, *J Med Internet Res* 2011, 13(2): e33.

[77] Macpherson, E., Dhaliwal, C., Richardson, J., The Relationship Between the Physical Functioning of Older Adults and Their Use of a Personal Health Record: A Systematic Review, *Curr Geri Rep* 2014, 3(3): 142-154.

[78] Karahanna, E., Straub, D.W., Chervany, N.L., Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs, *MIS quarterly* 1999: 183-213.

[79] An, J.-Y., Correlates and Predictors of Consumer's Health Information and Services Usage Behavior on the Internet: A Structural Equation Modelling Approach, Secondary "Correlates and Predictors of Consumer's Health Information and Services Usage Behavior on the Internet: A Structural Equation Modelling Approach", New York University, New York, 2005.

[80] Anderson, G., Patient decision-making for clinical genetics, *Nurs Inq* 2007, 14(1): 13-22.

[81] Stewart, M., Towards a global definition of patient centred care, *BMJ* 2001, 322(7284): 444-445.

[82] Bowen, D., Predictors of women's Internet access and Internet health seeking, *Health Care Women Int* 2003, 24(10): 940-951.

[83] Erasala, N., Yen, D.C., Rajkumar, T.M., Enterprise Application Integration in the electronic commerce world, *Computer Standards & Interfaces* 2003, 25(2): 69-82.

[84] Khoumbati, K., Themistocleous, M., Irani, Z., Integration Technology Adoption in Healthcare Organisations: A Case for Enterprise Application Integration, Secondary "Integration Technology Adoption in Healthcare Organisations: A Case for Enterprise Application Integration", 2005, pp. 149a-149a.

[85] Magdi N. Kamel, Moshe Zviran, Heterogeneous Databases Integration in a Hospital Information Systems Environment: A bottom-Up Approach, *AMIA* 1992: 363-367.

[86] RACGP, Collaboration in Primary Health Care: Case studies of Divisions of General Practice and Community Health Services working together, Secondary "Collaboration in Primary Health Care: Case studies of Divisions of General Practice and Community Health Services working together", RACGP, Melbourne, 1999.

[87] Piterman, L., Koritsas, S., Part I. General practitioner–specialist relationship, Secondary "Part I. General practitioner–specialist relationship", Blackwell Science Pty, 2005, pp. 430-434.

[88] C. Bridges-Webb, What the general practitioner does: morbidity in general practice, Sydney Univeristy Press, Sydney, 1986.

[89] Britt, H., Miller, G.C., Knox, S., Charles, J., Valenti, L., Henderson, J., General Practice Activity in Australia 2002-03: BEACH, in: *A.I.o.H.a. Welfare* (Ed.) Secondary "General Practice Activity in Australia 2002-03: BEACH"Canberra, 2003.

[90] Australian Medicare Local Alliance, 2012 General Practice Nurse National Survey Report, in: *A.P.H.C.R. Institute* (Ed.) Secondary "2012 General Practice Nurse National Survey Report", Australian Medicare Local Alliance, Manuka ACT, 2012.

[91] NSW Department of Health, Integrated Primary and Community Health Policy Implementation Plan 2007-2012: Implementation Plan, in: *NSW Department of Health* (Ed.) Secondary "Integrated Primary and Community Health Policy Implementation Plan 2007-2012: Implementation Plan", NSW Department of Health, Sydne, 2007.

[92] Wenck, B., Watts, I., Models of primary and community care in 2020 Secondary "Models of primary and community care in 2020 "Sydney, 2008.

[93] Bell, K., Couzos, S., Daniels, J., Hunter, P., Mayers, N., Murray, R., Aboriginal Community Controlled Health Services, Secondary "Aboriginal Community Controlled Health Services", 2000.

[94] van der Kam, W.J., Moorman, P.W., Koppejan-Mulder, M.J., Effects of electronic communication in general practice, *International Journal of Medical Informatics* 2000, 60(1): 59-70.

[95] Bates, D.W., Ebell, M., Gotlieb, E., Zapp, J., Mullins, H.C., A Proposal for Electronic Medical Record in U.S. Primary Care, *Journal of American Medical Informatics Association* 2003, 10(1): 1-10.

[96] Ebell, M.H., Frame, P., What Can Technology Do to, and for, Family Medicine?, *The Keystone Paper: Formal Discussion Papers From Keystone III* 2001, 33(4): 311-319.

[97] Little, P., Everitt, H., Williamson, I., Warner, G., Moore, M., Gould, C., Ferrier, K., Payne, S., Preferences of patients for patient centred approach to consultation in primary care: observational study, *BMJ* 2001, 322(24): 1-7.

[98] Campion, P., Foulkes, J., Neighbour, R., Tate, P., Patient centeredness in the MRCGP video examination: analsis of large cohort, *BMJ* 2002, 325: 691-692.

[99] Davis, K., Schoenbaum, S.C., Audet, A.-M.J., A 2020 VISION OF PATIENT-CENTERED PRIMARY CARE, *Journal of General Internal Medicine* 2005, 20(10): 953-957.

[100] Maloney, S., Ilic, D., Green, S., Accessibility, nature and quality of health information on the Internet: a survey on osteoarthritis, *Rheumatology (Oxford)* 2005, 44(3): 382-385.

[101] Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D., User acceptance of information technology: Toward a unified view, *MIS Quarterly* 2003, 27(3): 425 - 478.

[102] Venkatesh, V., Davis, F.D., A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies, *Management Science* 2000, 46(2): 186-204.

[103] Davis, F.D., User acceptance of information technology: system characteristics, user perceptions and behavioral impacts, *International Journal of Man-Machine Studies* 1993, 38(3): 475-487.

[104] Taylor, S., Todd, P.A., Understanding Information Technology Usage: A Test of Competing Models, *Information Systems Research* 1995, 6(2): 144-176.

[105] Fishbein, M., Ajzen, I., Belief, attitude, intention, and behavior: an introduction to theory and research: Reading, Secondary "Belief, attitude, intention, and behavior: an introduction to theory and research: Reading", Palgrave Macmillan Ltd, 1975.

[106] An, J.Y., Hayman, L.L., Panniers, T., Carty, B., Theory development in nursing and healthcare informatics: a model explaining and predicting information and communication technology acceptance by healthcare consumers, *ANS Adv Nurs Sci* 2007, 30(3): E37-49.

[107] Schnall, R., Bakken, S., Testing the Technology Acceptance Model: HIV case managers' intention to use a continuity of care record with context-specific links, *Inform Health Soc Care* 2011, 36(3): 161-172.

[108] Holden, R.J., Karsh, B.-T., The Technology Acceptance Model: Its past and its future in health care, *Journal of Biomedical Informatics* 2010, 43(1): 159-172.

[109] Yu, P., Li, H., Gagnon, M.-P., Health IT acceptance factors in long-term care facilities: A cross-sectional survey, *International Journal of Medical Informatics* 2009, 78(4): 219-229.

[110] Delone, W., McLean, E., Information systems success: the quest for the dependent variable, *Information Systems Research* 1992, 3: 60-95.

[111] Rogers, E.M., Singhal, A., Diffusion of Innovations (5^{th} ed), in: M. Salwen, D. Stacks (Eds.) An Integrated Approach to Communication Theory and Research, NJ:LEA, Mahwah, 2003, pp. 409-419.

[112] Davis, F.D., Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, *MIS Quarterly* 1989, 13(3): 319-340.

[113] Straub, E.T., Understanding Technology Adoption: Theory and Future Directions for Informal Learning, *Review of Educational Research* 2009, 79(2): 625-649.

[114] Venkatesh, V., Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model, *Information Systems Research* 2000, 11(4): 342-365.

[115] Davis, F.D., Bagozzi, R.P., Warshaw, P.R., User acceptance of computer technology: a comparison of two theoretical models, *Management Science* 1989, 35: 982-1003.

[116] Klein, R., An empirical examination of patient-physician portal acceptance, *Eur J Inf Syst* 2007, 16(6): 751-760.

[117] Klein, R., Internet-Based Patient-Physician Electronic Communication Applications: Patient Acceptance and Trust, *e-Service Journal,Special Issue: Research in e-Health* 2007, 5(2): 27-52.

[118] Tao, D., Understanding intention to use electronic information resources: A theoretical extension of the technology acceptance model (TAM), *AMIA Annu Symp Proc* 2008: 717-721.

[119] Lin, S.P., Yang, H.Y., Exploring key factors in the choice of e-health using an asthma care mobile service model, *Telemed J E Health* 2009, 15(9): 884-890.

[120] Wilkins, M.A., Factors influencing acceptance of electronic health records in hospitals, *Perspect Health Inf Manag* 2009, 6: 1f.

[121] Zhang, H., Cocosila, M., Archer, N., Factors of adoption of mobile information technology by homecare nurses: a technology acceptance model 2 approach, *Comput Inform Nurs* 2010, 28(1): 49-56.

[122] Tao, D., Intention to use and actual use of electronic information resources: further exploring Technology Acceptance Model (TAM), *AMIA Annu Symp Proc* 2009, 2009: 629-633.

[123] Legris, P., Ingham, J., Collerette, P., Why do people use information technology? A critical review of the technology acceptance model, *Information & Management* 2003, 40(3): 191-204.

[124] Yarbrough, A.K., Smith, T.B., Technology acceptance among physicians: a new take on TAM, *Med Care Res Rev* 2007, 64(6): 650-672.

[125] Cranen, K., Veld, R.H., Ijzerman, M., Vollenbroek-Hutten, M., Change of patients' perceptions of telemedicine after brief use, *Telemed J E Health* 2011, 17(7): 530-535.

[126] Shin, D.H., Kim, W.Y., Applying the Technology Acceptance Model and flow theory to Cyworld user behavior: implication of the Web2.0 user acceptance, *Cyberpsychol Behav* 2008, 11(3): 378-382.

[127] Chen, C.C., Wu, J., Crandall, R.E., Obstacles to the adoption of radio frequency identification technology in the emergency rooms of hospitals, *Int J Electron Healthc* 2007, 3(2): 193-207.

[128] Duyck, P., Pynoo, B., Devolder, P., Voet, T., Adang, L., Vercruysse, J., Do hospital physicians really want to go digital? --Acceptance of a picture archiving and communication system in a university hospital, *Rofo* 2008, 180(7): 631-638.

[129] Kijsanayotin, B., Pannarunothai, S., Speedie, S.M., Factors influencing health information technology adoption in Thailand's community health centers: applying the UTAUT model, *Int J Med Inform* 2009, 78(6): 404-416.

[130] Lin, C.P., Anol, B., Learning online social support: an investigation of network information technology based on UTAUT, *Cyberpsychol Behav* 2008, 11(3): 268-272.

[131] Cranen, K., Drossaert, C.H., Brinkman, E.S., Braakman-Jansen, A.L., Ijzerman, M.J., Vollenbroek-Hutten, M.M., An exploration of chronic pain patients' perceptions of home telerehabilitation services, *Health Expect* 2011.

[132] Rogers, E.M., Diffusion of innovations, The Free Press, New Yori, NY., 1995.

[133] Tung, F.C., Chang, S.C., Chou, C.M., An extension of trust and TAM model with IDT in the adoption of the electronic logistics information system in HIS in the medical industry, *Int J Med Inform* 2008, 77(5): 324-335.

[134] Aggelidis, V.P., Chatzoglou, P.D., Using a modified technology acceptance model in hospitals, *Int J Med Inform* 2009, 78(2): 115-126.

[135] Tung, F.C., Chang, S.C., A new hybrid model for exploring the adoption of online nursing courses, *Nurse Educ Today* 2008, 28(3): 293-300.

[136] Tornatzky, L.G., Klein, K.J., Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings, *IEEE Transactions on engineering management* 1982, 29(1): 28-45.

[137] Moore, G.C., Benbasat, I., Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation, *Information System Research* 1991, 12(3): 192-222.

[138] Yu-Bing Wang, Kuan-Yu Lin, Lily Chang, Hung, J.C., A Diffusion of Innovations Approach to Investigate the RFID Adoption in Taiwan Logistics Industry, *Journal of Computers* 2011, 6(3): 441-448.

[139] Avishwanath, A., Goldhaber, G.M., An examination of the factors contributing to adoption decisions among late-diffused technology products, *New Media & Society* 2003, 5(4): 547-572.

[140] Zmud, R.W., The effectiveness of External Information Channels in Facilitaing Innovation Within Software Development Groups, *MIS Quarterly* 1983, 7(2): 43-58.

[141] Helitzer, D., Heath, D., Maltrud, K., Sullivan, E., Alverson, D., Assessing or Predicting Adoption of Telehealth Using the Diffusion of Innovations Theory: A

Practical Example from a Rural Program in New Mexico, *Telemedicine Journal and e-Health* 2003, 9(2): 179-187.

[142] Chew, F., Grant, W., Tote, R., Doctors on-line: using diffusion of innovations theory to understand internet use, *Family Medicine* 2004, 36(9): 645-650.

[143] Lee, T.-T., Nurses' adoption of technology: Application of Rogers' innovation-diffusion model, *Applied Nursing Research* 2004, 17(4): 231-238.

[144] van der Weide, M., Smits, J., Adoption of innovations by specialised nurses: personal, work and organisational characteristics, *Health Policy* 2004, 68(1): 81-92.

[145] Ochieng, O.G., Ryozo, H., Factors influencing diffusion of electronic medical records: a case study in three healthcare institutions in Japan, *Health Information Management Journal* 2006, 34(4): 120 - 129.

[146] Tanriverdi, H., Iacono, C.S., Knowledge barriers to diffusion of telemedicine, Secondary "Knowledge barriers to diffusion of telemedicine"Atlanta, GA, USA, 1998, pp. 39-50.

[147] Greenhalgh, T., Stramer, K., Bratan, T., Byrne, E., Mohammad, Y., Russell, J., Introduction of shared electronic records: multi-site case study using diffusion of innovation theory, *BMJ* 2008, 337.

[148] Lee, J., Allaway, A., Effects of personal control on adoption of self-service technology innovations, *Journal of Services Marketing* 2002, 16(6): 553 - 572.

[149] Curran, J.M., Meuter, M.L., Self-service technology adoption: comparing three technologies, *Journal of Services Marketing*, 2005, 19(2): 103 - 113.

[150] Lee, H., Cho, H., Xu, W., Fairhurst, A., The Influence of Consumer Traits and Demographics on Intention to Use Retail Self-Service Checkouts, *Marketing Intelligence and Planning* 2010, 28(1): 46-58.

[151] Dabholkar, P.A., Bobbitt, L.M., Lee, E.-J., Understanding consumer motivation and behavior related to self-scanning in retailing: Implications for strategy and research on technology-based self-service, *International Journal of Service Industry Management*, 2003, 14(1): 59 - 95.

[152] Walker, R., Johnson, L., Why Consumers Use and Do Not Use Technology-enabled Services, *Journal of Services marketing* 2006, 20(2): 125-135.

[153] Reinders, M.J., Dabholkar, P.A., Frambach, R.T., Consequences of Forcing Consumers to Use Technology-Based Self-Service, *Journal of Service Research* 2008, 11(2): 107-123.

[154] Zeithaml, V., Parasuraman, A., Malhotra, A., Service quality delivery through web sites: A critical review of extant knowledge, *Journal of the Academy of Marketing Science* 2002, 30(4): 362-375.

[155] Parasuraman, A., Technology Readiness Index (Tri): A Multiple-Item Scale to Measure Readiness to Embrace New Technologies, *Journal of Service Research* 2000, 2(4): 307-320.

[156] Lin, J.-S.C., Hsieh, P.-L., The influence of technology readiness on satisfaction and behavioral intentions toward self-service technologies, *Computers in Human Behavior* 2007, 23(3): 1597-1615.

[157] Yen-Ting, H.C., Fang, S.-C., Tseng, C.-C., Early versus potential adopters, *International Journal of Retail & Distribution Management* 2010, 38(6): 443-459.

[158] Forsythe, S.M., Shi, B., Consumer patronage and risk perceptions in Internet shopping, *Journal of Business Research* 2003, 56(11): 867-875.

[159] Kim, L.H., Qu, H., Kim, D.J., A STUDY OF PERCEIVED RISK AND RISK REDUCTION OF PURCHASING AIR-TICKETS ONLINE, *Journal of Travel & Tourism Marketing* 2009, 26(3): 203-224.

[160] Cunningham, L.F., Gerlach, J.H., Harper, M.D., Young, C.E., Perceived risk and the consumer buying process: internet airline reservations, *International Journal of Service Industry Management* 2005, 16(3/4): 357-372.

[161] Cases, A.-S., Perceived risk and risk-reduction strategies in Internet shopping, *The International Review of Retail, Distribution and Consumer Research* 2002, 12(4): 375-394.

[162] Dabholkar, P., Bagozzi, R., An attitudinal model of technology-based self-service: Moderating effects of consumer traits and situational factors, *Journal of the Academy of Marketing Science* 2002, 30(3): 184-201.

[163] Nilsson, D., A cross-cultural comparison of self-service technology use, *European Journal of Marketing* 2007, 41(3/4): 367-381.

[164] Wu, S.-I., The relationship between consumer characteristics and attitude toward online shopping, *Marketing Intelligence & Planning* 2003, 21(1): 37-44.

[165] Simon, F., Usunier, J.-C., Cognitive, demographic, and situational determinants of service customer preference for personnel-in-contact over self-service technology, *International Journal of Research in Marketing* 2007, 24(2): 163-173.

[166] Cao, W., Wan, Y., Tu, H., Shang, F., Liu, D., Tan, Z., Sun, C., Ye, Q., Xu, Y., A web-based appointment system to reduce waiting for outpatients: A retrospective study, *BMC Health Services Research* 2011, 11(1): 318.

[167] Woodward, A., Fyfe, M., Handuleh, J., Patel, P., Godman, B., Leather, A., Finlayson, A., Diffusion of e-health innovations in 'post-conflict' settings: a qualitative study on the personal experiences of health workers, *Human Resources for Health* 2014, 12(1): 22.

[168] Culnan, M.J., The dimensions of accessibility to online information: implications for implementing office information systems, *ACM Trans. Inf. Syst.* 1984, 2(2): 141-150.

[169] O'Reilly, C.A., Variations in decision makers' use of information sources: The impact of quality and accessibility of information, *Academy of Management Journal* 1982, 25(4): 756-771.

[170] Rice, R.E., Shook, D.E., Access to, usage of, and outcomes from an electronic messaging system, *ACM Transactions on Information Systems (TOIS)* 1988, 6(3): 255-276.

[171] Karahanna, E., Straub, D.W., Chervany, N.L., INFORMATION TECHNOLOGY ADOPTION ACROSS TIME: A CROSS-SECTIONAL COMPARISON OF PRE-ADOPTION AND POST-ADOPTION BELIEFS, *MIS Quarterly* 1999, 23(2): 183-213.

[172] Chen, L.-d., Gillenson, M.L., Sherrell, D.L., Enticing online consumers: an extended technology acceptance perspective, *Information & Management* 2002, 39(8): 705-719.

[173] Vijayasarathy, L.R., Predicting consumer intentions to use on-line shopping: the case for an augmented technology acceptance model, *Information & Management* 2004, 41(6): 747-762.

[174] Chau, P.Y.K., Hu, P.J.-H., Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories, *Information & Management* 2002, 39(4): 297-311.

[175] Koufaris, M., Applying the Technology Acceptance Model and flow theory to online Consumer Behavior, *Information Systems Research* 2002, 13(2): 205-223.

[176] Pavlou, P.A., Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model, *International Journal of Electronic Commerce* 2003, 7(3): 101-134.

[177] Gilbert, D., Balestrini, P., Littleboy, D., Barriers and benefits in the adoption of e-government, *The International Journal of Public Sector Management* 2004, 17(4/5): 286-301.

[178] Moon, B.-J., Consumer adoption of the internet as an information search and product purchase channel: some research hypotheses, *International Journal of Internet Marketing and Advertising* 2004, 1(1): 104-118.

[179] Liao, H.-L., Lu, H.-P., The role of experience and innovation characteristics in the adoption and continued use of e-learning websites, *Computers & Education* 2008, 51(4): 1405-1416.

[180] Leedy, P.D., Ormrod, J.E., Practical research: Planning and Design, 8 ed., NJ: Prentice Hall, Upper Saddle River, 2005.

[181] Yin, R.K., Case Study Research: Design and Methods, Sage publications, Thousand Oaks, CA, 2003.

[182] Creswell, J.W., Clark, V.L.P., Designing and conducting mixed methods research, 2007.

[183] Sauer, C., Why information systems fail: a case study approach, Alfred Waller Ltd., Publishers1993.

[184] Levitt, J.I., Why physicians continue to reject the computerized medical record, *Minnesota Medicine* 1994, 77(8): 17-21.

[185] Anderson, J.G., Clearing the way for physicians' use of clinical information systems, *Communication of the ACM* 1997, 40(8): 83-90.

[186] Atkinson, C., Eldabi, T., Paul, R.J., Pouloudi, A., Investigating integrated socio-technical approaches to health informatics, Secondary "Investigating integrated socio-technical approaches to health informatics", 2001, pp. 10 pp.

[187] Berg, M., Aarts, J., Lei, J.v.d., ICT in Health Care: Sociotechnical Approaches, *Methods Archive* 2003, 49(4): 297-301.

[188] Sainfort, F., Jacko, J.A., Booske, B.C., Human-computer interaction in health care, in: A.J. Julie, S. Andrew (Eds.) The human-computer interaction handbook, L. Erlbaum Associates Inc.2003, pp. 808-822.

[189] El-Hassan, O., Fiadeiro, J.L., Heckel, R., Managing Socio-technical Interactions in Healthcare Systems, in: *A. ter Hofsterde, B.Benatallah, H.-Y. Paik* (Eds.) Secondary "Managing Socio-technical Interactions in Healthcare Systems", Springer-Verlag, Berlin Heidelberg, 2008, pp. 347-358.

[190] Herzlinger, R.E., Parsa-Parsi, R., Consumer-Driven Health Care, *JAMA: The Journal of the American Medical Association* 2004, 292(10): 1213-1220.

[191] Woerkum, C.M.J.v., van Lieshout, I.M., Reputation management in agro-food industries: safety first, *British Food Journal* 2007, 109(5): 355-366.

[192] Walker, G.H., Stanton, N.A., Salmon, P.M., Jenkins, D.P., A review of sociotechnical systems theory: a classic concept for new command and control paradigms, *Theoretical Issues in Ergonomics Science* 2008, 9(6): 479 - 499.

[193] Berg, M., Langenberg, C., Berg, I.v.d., Kwakkernaat, J., Considerations for sociotechnical design: experiences with an electronic patient record in a clinical context, *International Journal of Medical Informatics* 1998, 52(1-3): 243-251.

[194] Checkland, P., Systems Thinking, Systems Practice: Includes a 30-Year Retrospective, Secondary "Systems Thinking, Systems Practice: Includes a 30-Year Retrospective", Wiley, New York, 1993.

[195] Atkinson, C.J., Soft Information Systems and Technologies Methodology, SISTeM: A Case Study on Developing the Electronic Patient Record, *Requirement Engineering* 1997, 2(Volume 2, Number 1/ March 1997): 1-22.

[196] Vitacca, M., Mazzu, M., Scalvini, S., Socio-technical and organizational challenges to wider e-Health implementation, *Chronic Respiratory Disease* 2009, 6(2): 91-97.

[197] Platt, A., Warwick, S., Review of soft systems methodology, *Industrial Management + Data Systems* 1995, 95(4): 19.

[198] Australian Bureau of Statistics, 2011 Census QuickStats : Shellharbour (2011 3rd Release), in: *Australian Bureau of Statistics* (Ed.) Secondary "2011 Census QuickStats : Shellharbour (2011 3rd Release)", Australian Bureau of Statistics, Canberra, 2013.

[199] Checkland, P., Scholes, J., Soft systems methodology in action, John Wiley; Sons, Inc.1990.

[200] Holstein, J.A., Gubrium, J.F., The active interview, Sage Publications, Thousand Oaks, CA, 2004.

[201] Miles, M.B., Humberman, A.M., Qualitative Data Analysis: An Expanded Sourcebook, 2nd Revised ed., SAGE Publications Inc., Thousand Oaks, 1994.

[202] Murphy, E., Dingwall, R., Greatbatch, D., Paker, S., Watson, P., Qualitative research methods in health technology assessment: a review of the literature, *Health Technology Assessment* 1998, 2(16).

[203] Murray, M., Tantau, C., Same-day appointments: exploding the access paradigm, *Fam Pract Manag* 1999, 7: 45-50.

[204] Dexter, F., Design of Appointment Systems for Preanesthesia Evaluation Clinics to Minimize Patient Waiting Times: A Review of Computer Simulation and Patient Survey Studies, *Anesth Analg* 1999, 89(4): 925-.

[205] Erdem, H.I., Demirel, T., Onut, S., An Efficient Appointment System Design For Outpatient Clinic Using Computer, Secondary "An Efficient Appointment System Design For Outpatient Clinic Using Computer"San Diego, CA, 2002, pp. 299-304.

[206] Gupta, D., Dentona, B., Appointment Scheduling in health care: Challenges and opportunities, *IIE Transactions* 2008, 40(9): 800-819.

[207] Boyette, B., Staley-Sirois, M., Clinical no-show rates: is technology a contributor?, Secondary "Clinical no-show rates: is technology a contributor?", DIVURGENT, 2012, pp. 12.

[208] Horvath, M., Levy, J., L'Engle, P., Carlson, B., Ahmad, A., Ferranti, J., Impact of Health Portal Enrollment With Email Reminders on Adherence to Clinic

Appointments: A Pilot Study, *Journal of Medical Internet Research* 2011, 13(2): e41.

[209] Ahmad, N., Sidek, R.M., Omardin, M.A., E-Appointment Scheduling (EAS), Secondary "E-Appointment Scheduling (EAS)", 2010, pp. 695-699.

[210] Zhang, M., Zhang, C., Sun, Q., Cai, Q., Yang, H., Zhang, Y., Questionnaire survey about use of an online appointment booking system in one large tertiary public hospital outpatient service center in China, *BMC Medical Informatics and Decision Making* 2014, 14(1): 49.

[211] Klischewski, R., The Challenges of e-Appointment: Process Modeling, Infrastructure, and Organizational Context, 2009.

[212] Meyer, M., Levine, W.C., Brzezinski, P., Robbins, J., Lai, F., Spitz, G., Sandberg, W.S., Integration of Hospital Information Systems, Operative and Peri-operative Information Systems, and Operative Equipment into a Single Information Display, *AMIA Annual Symposium Proceedings* 2005, 2005: 1054.

[213] Ceri, F., Pelagatti, G., Distributed Database: Principles and Systems, McGraw-Hill, New York, 1984.

[214] Hsiao, D.K., Kamel, M., Heterogeneous Database: Proliferations, Issues, and Solutions, *IEEE Transactions on Knowledge and Data Engineering* 1989, 1(1): 45-62.

[215] Esmahi, L., Badidi, E., Edwards, J.W., Managing Demographic Data Inconsistencies in Healthcare Information Systems, *International Journal of Information Systems and Social Change (IJISSC)* 2010, 1(1): 56-72.

[216] Khoumbati, K., Themistocleous, M., Integrating the IT Infrastructure in Healthcare Organisations: a Proposition of Influential Factors, *The Electronic Journal of e-Government* 2006, 4(1): 27-36.

[217] Kenkel, M.B., Deleon, P.H., Mantell, E.O., Steep, A.E., Divided No More: Psychology's Role in Integrated Health Care, *Canadian Psychology* 2005, 4(3): 189-202.

[218] Zhang, J.K., Xu, W., Web Service-based Healthcare Information System (WSHIS): A Case Study for System Interoperability Concern in Healthcare Field, *Intl. Conf. on Biomedical and Pharmaceutical Engineering 2006 (ICBPE 2006)* 2006: 588-594.

[219] Papazoglou, M.P., Van Den Heuvel, W.J., Service-oriented design and development methodology, *International Journal of Web Engineering and Technology* 2006, 2(4): 412-442.

[220] Alonso, G., Casati, F., Kuno, H., Machiraju, V., Web Services: Concepts, Architectures and Applications, Springer, Berlin, 1998.

[221] Manes, A.T., Web Services: A Manager's Guide, Addion-Wesley, Boston, 2003.

[222] Chester, T.M., Cross-Platform Integration with XML and SOAP., *IT Professional* 2005, 9(4): 67-70.

[223] Ray, P., Mistry, D.P., Low, G., Hospital Information Systems based on CORBA and HL7, *HIC2000, Integrating Information for Health Care* 2000: 1-9.

[224] Krechel, D., Hartbauer, M., Maximini, K., LENUS - The Hospital Content Management System, Secondary "LENUS - The Hospital Content Management System", 2006, pp. 9-14.

[225] Weiping, W., Mingming, W., Shijun, Z., Healthcare information system integration: a service oriented approach, Secondary "Healthcare information system integration: a service oriented approach", 2005, pp. 1475-1480 Vol. 1472.

[226] Khoumbati, K., Themistocleous, M., Integrating the IT Infrasturctures in Healthcare Organisations: a Propositioin of Influential Factors, *The Electronic Journal of e-Government* 2006, 4(1): 27-36.

[227] Armitage, G.D., Suter, E., Oelke, N.D., Adair, C.E., Health Systems integration: state of the evidence, *International Journal of Integrated Care* 2009, 9(17): 1-11.

[228] Mrissa, M., Benslimane, D., Ghedira, C., Maamar, Z., A mediation framework for Web services in a distributed healthcare information system, Secondary "A mediation framework for Web services in a distributed healthcare information system", 2004, pp. 15-22.

[229] Barhamgi, M., Benslimane, D., Champin, P.-A., A Framework for Data and Web Services Semantic Mediation in Peer-to-Peer Based Medical Information Systems, Secondary "A Framework for Data and Web Services Semantic Mediation in Peer-to-Peer Based Medical Information Systems", IEEE Computer Society, 2006.

[230] Papazoglou, M.P., Heuvel, W.-J., Service oriented architectures: approaches, technologies and research issues, *The VLDB Journal* 2007, 16(3): 389-415.

[231] Mitchell, S., An extensive examination of web services: part 1, Secondary "An extensive examination of web services: part 1", Rolla.com, 2008.

[232] Ethan, C., Web Services Essentials, O'Reilly2002.

[233] Turner, M., Zhu, F., Kotsiopoulos, I., Russell, M., Budgen, D., Bennett, K., Brereton, P., Keane, J., Layzell, P., Rigby, M., Using Web Service Technologies to Create an Information Broker: An Experience Report, Secondary "Using Web Service Technologies to Create an Information Broker: An Experience Report", IEEE Computer Society, 2004.

[234] Pitts, N., Kirk. Chery, The XML Black Book, Coriolis Technology press2000.

[235] Hori, M., Ohashi, M., Applying XML Web Services into Health Care Management, Secondary "Applying XML Web Services into Health Care Management", IEEE Computer Society, 2005.

[236] Wiederhold, G., Genesereth, M., The conceptual basis for mediation services, *IEEE Expert* 1997, 12(5): 38-47.

[237] Bartel, M., Boyer, J., Fox, B., LaMacchia, B., Simon, E., XML-signature syntax and processing, *W3C recommendation* 2002, 12: 2002.

[238] Anzböck, R., Dustdar, S., Modeling and implementing medical Web services, *Data & Knowledge Engineering* 2005, 55(2): 203-236.

[239] Mykkänen, J., Riekkinen, A., Sormunen, M., Karhunen, H., Laitinen, P., Designing web services in health information systems: From process to application level, *International Journal of Medical Informatics* 2007, 76(2–3): 89-95.

[240] Nauman, R., Getting started with PHP and smarty, *Crossroads* 2008, 14(3): 9-16.

[241] Hayder, H., Gheorghe, L., Smarty PHP Template Programming and Applications, Packt Publishing Ltd2006.

[242] Neuhauser, L., Kreps, G.L., eHealth communication and behavior change: promise and performance, *Social Semiotics* 2010, 20(1): 9-27.

[243] Larose, R., Mastro, D., Eastin, M.S., Understanding Internet Usage: A Social-Cognitive Approach to Uses and Gratifications, *Social Science Computer Review* 2001, 19(4): 395-413.

APPENDIX A QUESTIONNAIRE SURVEY OF ONLINE APPOINTMENT SYSTEM

(Introduction begin)

Hi, my name is Xiaojun Zhang and I'm currently doing research at the University of Wollongong. I wonder if you'd mind if I ask you a few questions about how you made an appointment today.

(If patient asks about the purpose of the interview) well, the CHC has set up a way to make appointments on the internet and the information collected from patients today will help us to see how it could be improved to meet patients' needs).

We do not collect your personal identifying details, but could I first get some general background information?

(Start of questionnaire)

- Age: Gender: Male/Female

Work Status:

Full time Employed	
Part time Employed	
Unemployed	
Student	

Retired	

Highest level of education:

Primary and secondary school	
Certificate I – IV	
Diploma	
Bachelor	
Graduate Certificate	
Graduate Diploma	
Master or Above	

1. Would you mind telling me how old you are?

2. Could you please tell me your educational background? (If you need to be more specific, say: Did you complete the School Certificate? Did you finish Year 12 and do the HSC? Have you been to TAFE? Have you been to university?)

3. Are you working right now?
   - (If yes, ask: 'Is that full-time or part-time?')

4. Could you please tell me how you made this appointment with the doctor?

5. Have you seen the doctor yet?
   - IF NO:
     - How long have you been waiting?

6. When you made an appointment, were you able to get one as soon as you needed it?

7. Who did you see today?

8. How often do you usually make appointments at the CHC?

- daily,
- weekly
- monthly
- yearly

9. Are you satisfied with the health care services in this clinic?

10. Did you know that we have an online appointment system? (If yes, how did you find out?)

11. Do you have a computer with access to the internet at home?

    - IF YES AND THEY KNEW THE SYSTEM

- Did you use this online appointment system for making your appointment today?
    - IF YES:
        - Do you like to use it?
        - Is it easy to use?
        - Are you happy with it as it is or do you have any suggestions for improving it?

- On a scale of 1 to 10 where 1 means ‘not at all’ and 10 means ‘very satisfied’, how would you rate your satisfaction with the CHC online appointment system?
- IF NO:

- Have you ever logged onto the online system?
- Why didn’t you use it this time?

- IF THEY DIDN’T KNOW ABOUT THE SYSTEM
  - Now that you know about the online appointment system, do you think you would use it for making appointments?

12. Would you like to use online appointment service next time?

13. Would you recommend the CHC online appointment system to your friends or family who has computer access? Why or why not?

14. Compare online booking with ringing reception at CHC directly, which way do you prefer to make an appointment:
    - by phone,
    - online
    - or just walking in?

    Why is that?

15. Do you use the internet to search for medical or health-related information? Why? How often would you say you do this?

16. Could you be more specific about which types of information you look for on the web?
    - (If they have difficulty answering you could ask: emergency information? Lab or test results? Waiting times? Personal medical records? Info about other health services?).

17. Is there any other information you think that the CHC should make available on the internet?

18. Do you know anything about the national electronic health records scheme?
    - (If they ask what the PCEHR is: well, this is a program which, with the patient's consent, will allow doctors, pharmacies and hospital to have access to a patient's record. It is aimed at preventing the kind of medical mistakes which happen when the necessary information about a patient's medical history is not available.)

19. Do you think you would like to opt into this system? Why or why not?